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ABSTRACT

This manual identifies the essential design elements of modern, high quality learning environments and includes discussions on facility programming, management, utilization, evaluation, and planning for future technology. Classrooms examined include general purpose classrooms, lecture halls, seminar rooms, and specialized classrooms such as distance education and interactive video classrooms. Separate guidelines are presented for each classroom type. The manual also explores the use of technology in classrooms, discusses a team planning approach to programming for classroom design, offers advice on equipment security and on meeting accessibility regulations, and provides practical applications for surveying classrooms using illustrative checklists. Appendices contain designing issues involving accessibility under the Americans with Disabilities Act; regulations, codes, and compliance agencies; a bibliography of books and articles on classroom design; a list of professional organizations involved in facility design; the authors' biographies; and photos of sample classroom designs. (GR)

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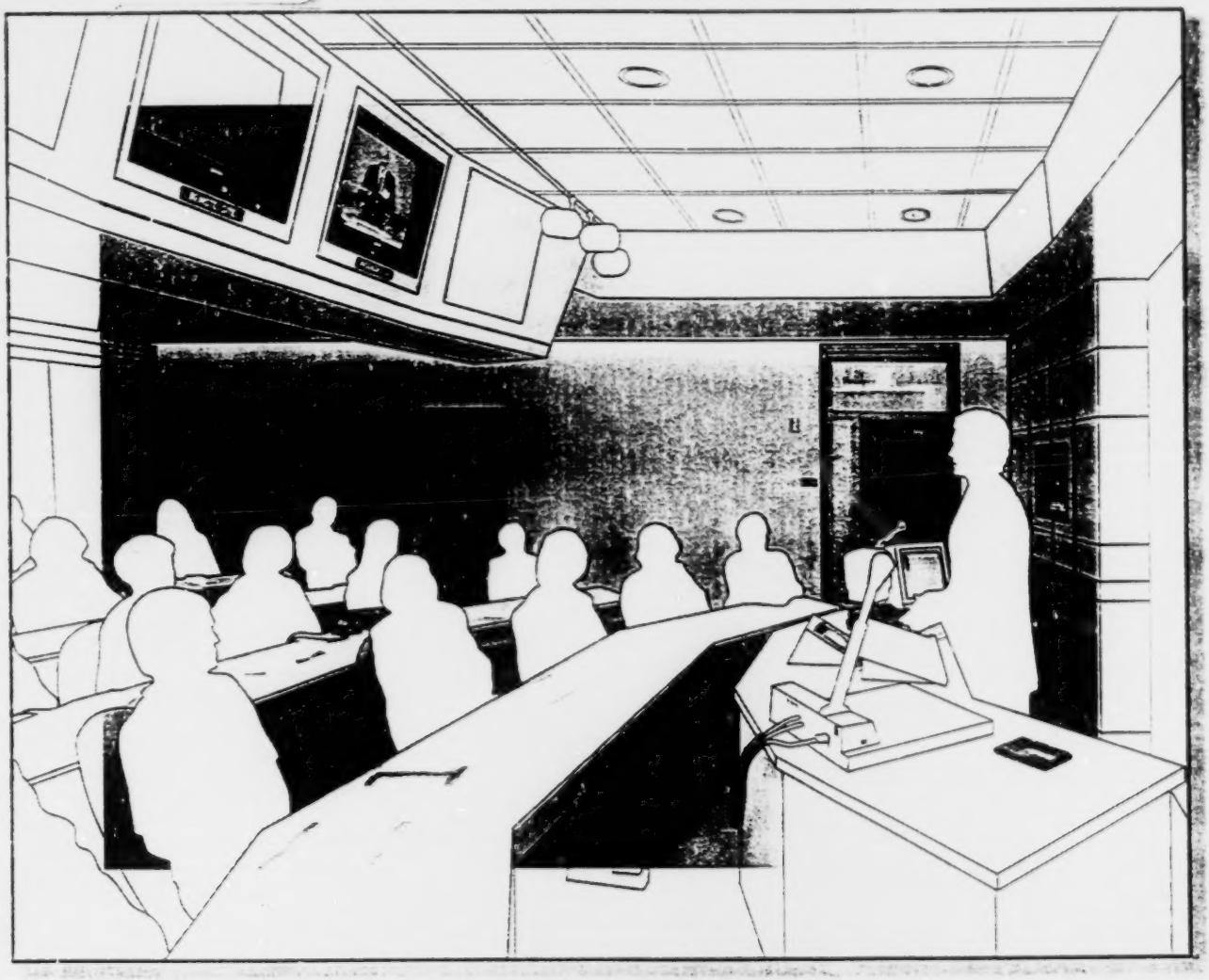

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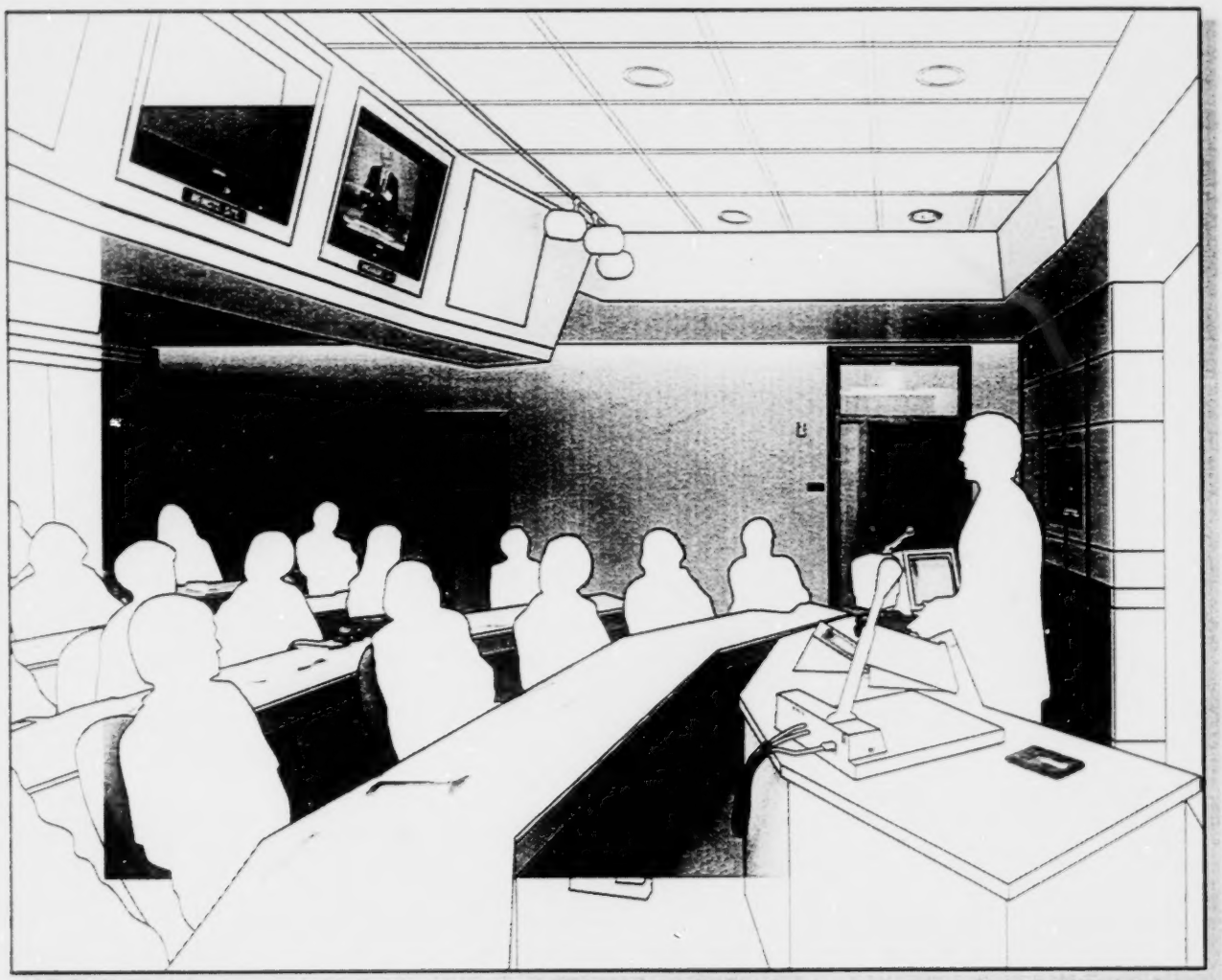

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INTRODUCTION

Six years ago when the first edition of *Design of General Purpose Classrooms and Lecture Halls* was published, very little attention was given to the design and planning of instructional spaces. Classrooms typically were afterthoughts of construction in large comprehensive building programs.

Today, technology and an increased emphasis on undergraduate education have rekindled interest in classroom design. Institutions now invest significant amounts of scarce funds to "bring classrooms into the modern century." Colleges and universities recognize that to recruit and retain good students and faculty, modern and well-equipped instructional facilities are as important as modern and well-equipped research facilities. This manual represents a collaborative effort by experienced professionals from seven major universities to identify the essential design elements of modern, high quality learning environments. Other topics crucial to the provision of quality learning spaces are also discussed, including facility programming, management, utilization, evaluation, and planning for future technology.

A fundamental tenet has guided each of the three editions of this publication. Students have a fundamental right to a classroom learning environment that allows them to see anything presented visually, to hear any audible presentation free from noises and distortions, and to be physically comfortable (air flow, temperature, furniture, etc.) regardless of the method of instruction used. Any classroom design plan should first meet these requirements before meeting other needs. Likewise, any existing classrooms that do not meet these basic criteria should be corrected immediately or removed from the classroom inventory.

Three categories of classrooms are described: (1) general-purpose classrooms, designed to house 75 or fewer students with at least 350 square feet and a minimum capacity of 20 students; (2) seminar rooms, which are smaller in capacity and area with a table and chairs arrangement; and, (3) lecture halls, designed for formal presentation modes of instruction for more than 75 students. Separate guidelines have been prepared for each type of classroom; however, the lines between them are not absolute and require some interpretation based on individual facilities and applications.

As in earlier editions, the guidelines and definitions emphasize instruction type and design characteristics, and *do not conform* to the standards and definitions of the Higher Education General Information Survey (HEGIS), the Classification of Instructional Programs (CIP), or any other published standards of room classifications.

The authors make no attempt to prescribe absolute standards for all classroom construction and renovation. We hope this book will serve as a guideline to help institutions account for the wide variety of factors that go into making an effective classroom environment. Classroom design encompasses an enormous number of variables and adaptations must fit the specific institutional needs, mission, and culture as well as comply with applicable state and local codes.

Well-designed classrooms do not occur by chance. An attitude must be fostered among faculty, students and administrators that reinforces the idea that classrooms are the responsibility of everyone. Generally, offices, conference rooms, laboratories, and other spaces have their own advocacy group or responsible department but general classrooms are an institutional resource that belongs to everyone. For this reason, we recommend that, in addition to using these guidelines to direct the improvement of instructional spaces, each

institution carefully consider assigning the role of advocacy to a specific group on campus. Further, that group should include facilities planners and administrators, faculty, students, media support personnel, physical plant staff, and administrators who are concerned about the quality of instructional space on campus.

The first edition of this manual focused on general purpose classrooms and lecture halls. The second edition expanded to cover seminar rooms, addressed briefly other issues that have a major impact on design (technology and accessibility), and provided an overview of issues related to the evaluation and management of classrooms. This edition will elaborate more on the use of technology in classrooms, discuss a team planning approach to programming for classroom design, offer advice on equipment security and on meeting accessibility regulations, introduce the some general guidelines for specialized learning spaces such as distance learning and computer classrooms, and provide practical applications for surveying classrooms using illustrative checklists.

This information is provided as practical advice from experienced professionals. These general guidelines should be adapted to specific situations according to the culture and operational practices of each institution. The guidelines can be useful in major renovations and in the construction of new classrooms. They are intended to be used as a tool and should not be substituted for the development of specific program statements, which define the needs of the instruction that will take place in the classroom(s). Given the dynamic nature of technological advances, no one can predict the form that instructional technology will take during the lifetime of any classroom built today, but the application of these guidelines will create instructional spaces that are as adaptable as possible to the needs of the future.

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CHAPTER 1

THE PLANNING PROCESS

INTRODUCTION

Good classroom design begins with good classroom management, organizing the various campus units responsible for all aspects of classrooms to work together effectively, and establishing policies that encourage cooperation and teamwork. Only with an organizational approach to planning will classrooms be designed to facilitate the instructional mission. This means that the focus of all classroom design efforts must be the users.

- More emphasis should be placed on installing proper adjustable lighting and temperature control in classrooms rather than just saving energy;
- User support should focus on providing faculty with better training and development support for using media in classrooms rather than equipment checkouts and delivery procedures;
- Design of classrooms should meet the true needs of the teachers and students who will use the room rather than simply replicating what was done on previous projects.

PROGRAM PLANNING TEAM

Membership on the Planning Team should be diverse and include representatives from academic affairs and/or financial services, facility planning office, scheduling or enrollment office, physical plant, instructional media services, computing services, telecommunications services, health and safety office, the faculty and the student body. For facilities shared by various departments, it is also important to have a mix of individuals from different disciplines. Individuals representing the engineering sciences, fine and applied arts, life sciences, agriculture, education, law, humanities and the social sciences, for example, would provide different perspectives on the types of instructional methods and learning environments best suited to their disciplines. For that reason, the Planning Team must work closely with faculty and students to identify the physical features and instructional capabilities of greatest importance and which best support their instructional and learning requirements.

QUALITY DESIGN STANDARDS

The Planning Team should develop quality standards for the design of instructional spaces. This manual offers current standards to use as a guideline.

DOCUMENTATION AND EVALUATION

A "needs assessment" which compares existing instructional spaces against the quality standards should be conducted by the institution to identify deficiencies. The first step in the assessment process is to systematically document existing instructional facilities using an inventory checklist. Chapter 7 contains a more complete discussion on this subject.

A weighting and scoring system should be developed for classroom design elements that reflects the institution's priorities and requirements. A comprehensive score should be developed for each classroom representing the extent to which that classroom approximates the standards. The results of this scoring system can determine the relative condition of instructional spaces and a prioritized plan for improving these spaces can be developed by the committee.

CLASSROOM IMPROVEMENT PLAN

The classroom audit provides the basis for developing a classroom improvement plan that identifies the rooms to be renovated or newly constructed, the estimated cost for each room, and the estimated timetable for implementing the plan. A funding strategy can then be established.

Since enrollment is usually lower during the summer, most renovations occur during this limited window of opportunity. Careful consideration must be given to determine how many rooms can be taken out of service at the same time.

PROJECT PROGRAM STATEMENT

Prior to the design for the renovation or construction of instructional spaces, a statement of program requirements should be developed for each project. The program statement serves as a means to communicate requirements to the designer and a guideline to assist the planning team in reviewing drawings. Program requirements will be based on the institution's design standards and the specialized requirements for the individual project being designed. In-house specialists and/or private consultants can provide technical guidance in developing requirements for specialized lighting, acoustics, telecommunications and instructional media.

LOCATION OF CLASSROOMS

In determining the quantity, location, and distribution of instructional spaces to be renovated or added, the planning committee should review the campus master plan. Historical demand for specific types and capacities of rooms should guide location decisions.

MAINTAINING AN ACCURATE INVENTORY AND UTILIZATION SYSTEM

Accurate information about the current classroom inventory and the common utilization rates of various classrooms is an essential part of good classroom management. Before planners can determine what is needed to meet the institution's instructional needs, they must first understand what classrooms exist and how they are currently used. In addition to simple utilization rates, planners should compare class sizes against the current capacity size ranges of its classroom inventory. Chapter 7 contains more information on this topic.

SCHEDULING POLICIES

Institutions should develop operational policies that outline the general time and day schedules for academic units to follow when scheduling classes. Common start times and day rotations are important in making effective use of all classrooms. Exceptions to a common time and day schedule should be permitted only if the course requires no classroom space that can be used by other units, and creates no scheduling conflicts for students who wish to enroll in additional courses. For more details regarding operational management practices and policies, refer to Chapter 7.

TECHNOLOGY ADVANCES

The Planning Committee must remain current on changing teaching and learning strategies, especially those which involve advances in technology. The simplest way to keep abreast of these changes is to include the faculty and students--the people most affected by classroom design--in the planning process. They can identify and explain how today's teaching and learning methods affect the instructional process inside and outside the classroom. They can explain, for example, how traditional configurations of classroom seating affect the collaborative learning process and the group teamwork approach used in many classes today.

New technology requires a continuous reassessment of what is the most effective way to teach a topic or discipline. Colleges and universities must keep pace with these technology developments if they are to maintain or expand current enrollments.

POLICY ISSUES ON TECHNOLOGY

All institutions feel pressure to keep pace with new technologies, but few have the resources to do so. Most seek a level of balance between keeping abreast of the latest technological innovations and increasing access so that technology is available broadly enough that it can be integrated into the entire academic program of the institution.

Institutions use a variety of approaches to address these issues. Some focus the majority of their resources in support of those disciplines which rely heavily on technology. Others try to spread out the resources so that all disciplines have access to at least the most basic technology. Striking the right balance between the degree of support for "haves" and "have nots" is not easy. In addition, institutions must address the issue of how much effort should be put into providing hardware versus support services.

ORGANIZING TO SUPPORT TECHNOLOGY

On the organizational side, some institutions have a strong centralized planning and support service structure while others have taken a more decentralized approach that relies on individual units to meet their own needs. Some institutions have both centralized units that provide services which are more sophisticated or that benefit from economies of scale as well as decentralized support units which provide routine, day-to-day support or services which are specific to a particular discipline. The decision about which approach to take often depends on a variety of factors, such as size, the way the institution has historically provided other kinds of support services, and resources.

On many campuses, technology is supported by various organizations (academic computing, administrative computing, telephone communications, audiovisual, libraries). As technology has evolved, many of the distinctions that caused these separate units to emerge have blurred and efforts must be made to insure coordination and elimination of any unnecessary duplication. On some campuses, such units have been reorganized under a Chief Information Officer so that the organizational structure promotes more effective coordination of effort and easier access to services by users. If a unified organizational structure for technology does not exist, it is critical that these units work closely together even though they may report to different campus administrators.

Given the increasing complexity of the issues surrounding technology support, it is important that institutions establish the appropriate policy and planning structures, as well the organizational structure which provides the services. Despite the fact that the number of interested parties and the diversity of their needs is increasing, some campus-wide group (or groups) should be established to deal with these issues, including: establishing policies, establishing standards, reviewing organizational patterns, etc. To be effective, the group should represent a broad spectrum of the user community including those responsible for serving users as well as the users themselves. Planners must remain current on changing learning/teaching styles and strategies and the dynamic advances in presentation technologies. A critical factor is to provide an infrastructure that permits flexibility to adopt future technologies. As with any campus-level policy group, communicating and disseminating information to the entire campus community is essential.

The application of technology in the classroom entails an organizational responsibility, a commitment to the instructional faculty who redesign their courses to utilize the technology.

This commitment encompasses two tracts. First, the institution must establish operational procedures so that technology will work properly when students and faculty enter the classroom to begin class. When electronic malfunctions occur, the institution must provide a quick response to solve the problem so that important instructional time is not lost. Second, the institution must provide an adequate number of appropriate staff support for the units charged with classroom support responsibility.

FACULTY AND SUPPORT STAFF TRAINING FOR TECHNOLOGY

Most new instructional technologies are more complex to set-up, use and maintain than traditional audiovisual instructional equipment. Adequate technical staff are needed to design, select, install, and maintain facilities, and to support users. Because these staff assist and train faculty and student users as well as troubleshoot and maintain the equipment, they must have the opportunity to receive specialized training, such as that provided by manufacturers, dealers, trade groups, professional associations, etc.

In addition, faculty must receive detailed, periodic training on the operational use of technology. More simply stated, faculty must be taught how to operate the classroom equipment, and how to use it in the most effective manner. Also, the institution must offer faculty more in-depth professional development opportunities, such as adequate time and access to skilled support staff and equipment to revamp existing materials and develop new and innovative instructional materials that will integrate technology effectively into their teaching/learning activities.

LIFE CYCLE FUNDING AND RESOURCES FOR TECHNOLOGY

There must be an institutional commitment to a budget plan that covers instructional technologies. Life cycle funding is one way to support the dynamic changes that are taking place in the area of computers and related video and electronic data display systems. In many cases, older computers can be recycled to other uses, although older display and projection systems seldom find alternative uses. Life cycle plans should be developed according to economic and planning factors unique to each institution.

Another strategy that allows institutions to leverage scarce resources is to provide support for computing technology is to encourage or subsidize student computer purchases. This way, the institution invests mostly in infrastructure support that typically endures longer. If students purchase their own machines for general use, then scarce campus resources can be focused on providing support, hardware and software for instructional or specialized applications. And negotiating agreements with technology vendors, such as Internet Service Providers or telecommunications companies, may provide ways to lessen infrastructure costs while providing reasonably priced services that faculty and students can afford.

INFRASTRUCTURE

Common components of the infrastructure include such items as lighting and light control, electrical power, conduit, acoustics, seating, and HVAC. As more technologies are incorporated into classrooms these components and their relationship to each other become more critical. Detailed discussion of these components is presented in other sections of the manual. With the introduction of the computer and a variety of distance learning formats the connection of classrooms to the campus network and its several sub-networks (local, wide area, and world wide) is essential. In anticipation of these connections, conduit with pull lines and trays should be planned, designed, and installed.

Frequently central funding is provided for the campus network backbone, but not for internal wiring at the building and individual room level. Therefore, the development of a

master technology plan should include funding for all network needs in all types of buildings where users may need access (academic, administrative, student services, and residence halls).

REVIEW OF CLASSROOM IMPROVEMENT PLAN

The classroom improvement plan should be reviewed and updated at regular intervals. For remodeled or newly-constructed classrooms, a post occupancy evaluation should be conducted approximately one semester after completion. Faculty and students who have used the room (ideally both before and after remodeling took place in the case of renovations) and the classroom planning team should be surveyed or brought together in focus groups to evaluate the classrooms. The post occupancy evaluation should compare the original functional objectives and design criteria to how the rooms are actually being used with particular emphasis on users' evaluation of their capabilities. This information should be fed back into the improvement plan in the form of revised or expanded design standards.

The classroom improvement plan should include an estimated timetable and budget for repair, replacement, and renovation of remodeled and newly-constructed classrooms and lecture halls to ensure their continued viability in the future.

CHAPTER 2
FACILITY DESIGN ELEMENTS

INTRODUCTION

The discussion of classroom design guidelines must begin with a few general principles about the location of classrooms and the structures that contain them. This chapter emphasizes the design guidelines common to all types of instructional spaces. For specific guidelines on general purpose classrooms, lecture halls, and seminar rooms, refer to Chapters 3, 4, and 5.

SITE AND SPATIAL RELATIONSHIPS

Classrooms should be placed on the lower floors of buildings to provide better student access and more convenient instructional support services. A building with mixed functions (classrooms, offices, and/or laboratories) should separate the classroom core from other functions.

Classrooms should be separated from noise-generating activities inside or outside the building. To reduce external noise, sound buffers must separate classrooms from areas such as streets, parking lots, housing areas, plazas or other areas where students gather, recreation sites, athletic fields, trash pickup sites, and loading docks. To reduce internal noise, classrooms should be isolated from building mechanical systems, elevators, restrooms, vending areas, and other noise generating areas.

BUILDING ENTRANCES

To reduce the impact of exterior noise and temperature differences, all building entrances should have two sets of doors, one from the outside into a vestibule and a second from the vestibule into the building.

The main criterion in determining where to locate building entrances should be the direction(s) from which students and other pedestrians approach the building. Entrances should be near classrooms to limit the distance students must travel through non-instructional areas to reach classrooms. Large numbers of students walking through hallways can disturb classes already in session. Larger capacity classrooms should be located closest to the building entry.

Local building codes should be only one of several criteria that should determine the number and location of building entrances. Equally important is to plan for a flow of students between classes that is double the capacity of the rooms served by an entrance. Students often arrive for class at the same time students are leaving the classroom.

If classrooms must be located on upper floors, the stair towers and the doors into stair towers must accommodate the number of students who may leave and arrive at the same time.

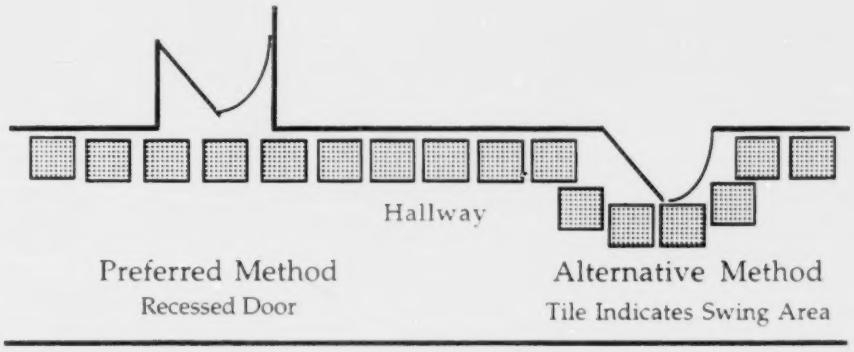
DOORS

All classroom and lecture hall doors should be a minimum of three feet wide and should have a vision panel in order to prevent injury when being opened. Vision panels should contain shatter-resistant glass that is tinted to reduce light transmission. The area of the glass should not exceed 100 square inches. The base of the vision panel should be no higher than 42 inches above the floor, and the top of the vision panel should extend at least 62 inches above the floor. All classroom doors should have levers (not knobs) for easier use by people with disabilities.

The doors should be equipped with hardware that results in a slow and quiet closure to a tight sound seal when fully closed. To facilitate traffic flow, the doors should be capable of standing open during the change of classes. All exits from classrooms and lecture halls should conform to prevailing codes regarding panic hardware for use in case of emergencies. Door opening force, hardware, width, thresholds, and maneuvering clearance should conform to ADA standards (See APPENDIX A).

If locks are installed in the doors, they should be deadbolt locks which are key- or card-activated, not push button. Doors should not contain ventilation louvers because they permit transmission of sound and fumes. Kick plates installed on the egress side of doors will protect them from bumps and scratches.

Doors should be located to minimize congestion problems in the hallway when classes are changing. When possible, doors should be recessed into the room so that the door does not swing into the hallway. If it is necessary for the door to open into the hallway, some kind of visual identification (such as the tile pattern in the floor) can be used to indicate the amount of space that the door will occupy when it swings open. Doors should not swing into the primary flow of traffic. This will minimize the danger of someone in the hallway walking into the leading edge of the door.



VENDING AREAS

Vending machines should not be located in the lobby area outside a lecture hall. Vending areas should be placed in remote locations away from classrooms, preferably in an alcove or other similar location that will minimize congestion and noise when students use the machines.

The vending area should have trash/ recycling containers in the immediate area of the vending machines. Any trash/recycling containers in the lobby area should complement the interior decor of the lobby area.

RESTROOMS

Restrooms should be located on each floor, and the capacity of the restrooms should be calculated according to the number of students in the area during class change time rather than to the capacity of the classrooms. To prevent noise transmission, in no case should there be a common wall or ceiling between any classroom and the restrooms. In new construction, each public and common use toilet room shall be accessible to persons with disabilities.

Lecture halls often are used for a variety of activities in the evening which means that access to restrooms is needed.Restrooms should be so located in the building that they can remain open in the evening, even if the remainder of the building is closed.

DRINKING FOUNTAINS

Preferably 50 percent of all, but at least one drinking fountain per floor, should be accessible and should be located on an accessible route.

TELEPHONES

A public telephone should be located in a visible area near the lobby or entrance area of the building. The telephone should be located near lecture halls and installed so that they do not obstruct the normal flow of traffic through the lobby area. The telephone should be accessible to persons with disabilities, equipped with a variable volume-control feature for people who are hearing-impaired and located at an appropriate height for persons who use wheelchairs.

BUILDING DIRECTORY

A directory that identifies classroom locations should be provided at each entrance along with a directory of other programs and activities located in the building. If multiple corridors leadaway from a point of entry to a floor, directional signs should indicate the location of classrooms. Refer to APPENDIX A, for signage accessibility requirements.

SIGNAGE

Signage in and arcund a classroom should be kept to a minimum and should be coordinated with other signs and with the general decor of the area.

All classrooms should have a room identification number on the wall next to the door. These numbers should be accessible to and meaningful to all students in accordance with local code. There should be information located inside and outside each classroom regarding how to report problems with physical facilities and with equipment in the classroom.

When movable seating is used, the capacity of the room should be prominently posted within the room. This will assist the custodial staff in maintaining the proper number of seats in the room.

FINISHES

Color and Reflectance Values

The selection of color and the reflectance values of finish materials must be considered for all classrooms. Painted surfaces should be a light color, and should have a durable finish to allow washing. A soft matte finish marks easily, is difficult to clean, and, therefore, should be avoided.

Special care must be given to rooms where televised instructional activities will originate. Light blue and gray are good choices for these areas. In addition, all finishes should be non-glare.

The reflectance value of paints, vinyl coverings, laminates, and other finish materials should be selected to enhance ambient illumination and the illumination at working surfaces. The following values are recommended by the Engineering Society of North America:

SURFACE REFLECTANCE VALUES

Ceilings	80 percent or higher
Walls	50 to 70 percent
Floors	20 to 40 percent
Desktops	25-45 percent

In addition to reflectance, work surfaces should have a matte finish. Reflectance values can be found in selection charts and samples.

A person's eyes move toward the brightest object in its field of vision. Thus, lighting should highlight what is most important to see--the task at hand. The desk surface should contrast sharply from the paper, book, or computer screen where the task is performed.

Floors

The floor in the general classroom should be vinyl or rubber tile and should have a smooth surface. Industrial grade, stain resistant carpet is rapidly becoming an acceptable floor finish in classrooms because it provides valuable acoustical properties to the room, and because its increasing durability makes it as easy to maintain as vinyl floors. If carpet is installed, consideration should be given to its effect on the acoustics in the room.

The floor covering should be a medium to light color and should contain some kind of subdued pattern or fleck to break the monotony and to make it less likely to show dirt and stains. A four-inch cove base should be installed around all of the walls.

HALLWAYS

The design of buildings that contain classrooms should recognize that students will be in the hallways or public areas while classes are in session. This means that built-in or permanently affixed seating should be provided. If there are no seats, students will sit on the floor, interrupting traffic flow through the hallways.

The lower portion of the hallway walls should have a very durable surface because of normal wear and tear. Sound-absorbent material may be applied to the upper portion of hallways, starting about seven feet above the floor, to provide for control of sound in these public areas.

Any changes in floor elevation in a hallway should make provisions for wheelchair and equipment passage through the use of a ramp. Gently sloped ramps (1:20 or less in slope) are typically easier for persons with disabilities to negotiate than steeper, although more direct routes. Ramps must not exceed one foot rise in twelve feet of run and handrails are required if the run exceeds 72" or rise exceeds 6". Level landings are required every 30' of run and wherever a ramp changes direction. See APPENDIX A for a more complete discussion of accessibility requirements.

The floors of hallways should be smooth to minimize noise and to facilitate the movement of equipment carts and wheelchairs. Floors also should have a nonskid surface, especially near the outside entrances.

To improve acoustics and create visual interest, a variety of materials and colors should be used in hallways and other public areas.

EQUIPMENT STORAGE

Adequate and secure storage for all types of instructional equipment must be provided near the classrooms. This storage should be accessible from the hallway and not require entering through another classroom. Any classroom located on a floor that is not accessible by an elevator should have storage provided for instructional equipment and cart(s).

Special considerations must be given regarding security of any equipment that is permanently assigned to a general classroom. All equipment should be firmly secured and clearly marked in a way that makes the identification difficult to remove.

SEATING DESIGN CHARACTERISTICS

Anthropometrics, the comparative study of human body measurement, should be considered when designing classrooms to make certain that furnishings and equipment will be suitable for the persons for whom the space is intended. Generally, when designing for institutional use, equipment and furnishings should accommodate the "tallest and the smallest" persons; that is, everyone within the 5th to the 95th percentiles. This means that five percent of the population will be too small to be comfortable, and five percent will be too large to be comfortable. According to Panero and Zelnik in *Human Dimension & Interior Space, A Source Book of Design Reference Standards,* classrooms should be designed for 5th percentile females (104.5 pounds and 60 inches) to 95th percentile males (215.4 pounds and 74.3 inches).

In establishing which percentile to use for each dimension, the following guidelines are useful.

- To define clearance areas (lines of sight, aisles, seat widths, thigh clearance, etc.), use the 95th percentile.

- To establish vertical-grip reach, heights of equipment, seat height and depth, and placement of audio-visual equipment and controls, use the 5th percentile.

- To define lines of sight, pivot movements and positions, the limit of visual field in the horizontal and vertical planes should never be exceeded. The design should account for normal line of sight, limit of color discrimination, and the actual limit of visual field.

To accommodate larger individuals, it may be desirable to provide a variety of chair widths and put the wider ones along the aisles.

ACOUSTICS

Good listening conditions (i.e. a quiet room) depend on four basic factors:

- the amount of noise entering the room from outside sources
- the loudness of the various sound sources within the room (with or without amplification)
- the distribution of sound to all parts of the room
- the fidelity and clarity of the sound (lack of reverberation, distortion, etc.)

Perhaps the single most important factor related to good acoustics is the absence of noise from external sources since this interferes with sound created within the room. Even a room with good internal acoustical properties and sound systems cannot overcome extensive noise infiltration.

Walls

Walls in classrooms and lecture halls should have a minimum sound transmission class (STC) rating of 50. All walls must extend to the floor above or to the roof construction, and not stop at the ceiling. This will reduce noise transmission as well as improve security.

Higher STC ratings and special wall-construction details must be included whenever classrooms must be located adjacent to, above, or below restrooms, mechanical rooms, elevator shafts, athletic facilities, or other sources of high noise levels or where the classroom function generates a significant amount of noise, such as a music room.

Concrete masonry units may be used as structural walls, but may have to be covered with another finish in order to provide proper acoustics.

Folding walls should not be used in classrooms because it is difficult to have a folding-wall design that will maintain adequate sound separation between classrooms over an extended period of time.

Ceiling

Sound must be loud enough to be heard by people sitting in the rear of the room as well as those in the front. The ceiling is the most critical element inside the room in assuring effective distribution and appropriate volume of sound throughout the room. The ceiling should act as a sound mirror, reflecting sound downward to blend with the direct sound. This is why the ceiling should include significant amounts of hard surfaced material. Too many classrooms and lecture halls have ceilings composed entirely of sound absorbing acoustical tile that offer little or no sound sound reflection. This leads to a significant and undesirable difference in volume and distribution of sound within the room.

The surface of the ceiling must be designed to accommodate the required acoustical properties of the room. The area of the ceiling that should be covered with acoustical tile is related to ceiling height.

CEILING SURFACES

Ceiling Height	Proportion of Acoustic Tile
8 feet clearance	40 to 50 percent
10 feet clearance	50 to 60 percent
12 feet clearance	50 to 60 percent

These numbers presume the use of Noise Reduction Coefficient (NRC) .55-.65 tile in a ceiling suspension system. The acoustical tile should be arranged in horse-shoe configuration around the perimeter of the room, with the opening at the front and the rest of the ceiling a hard material such as gypsum board or plaster.

Reverberation in general purpose classrooms is normally not a concern, although it can be critical in larger rooms and lecture halls. If a reverberation problem exists, applying a small amount of acoustical material to the walls in the rear portion of the room may provide sufficient deadening to handle the problem.

Insulation from Mechanical System Noise

The mechanical system supporting general purpose classrooms should generate a background noise of no more than NC 35. To achieve this, the HVAC system requires careful design, competent installation and balancing, and regular maintenance. Factors that influence the design of a quiet operating system include air handlers or fans located away from the classrooms; low velocity of air within the room; and proper sizing and acoustical treatment of ducts, returns, and diffusers.

Inadequate or improperly sized mechanical systems often cause acoustical problems for classrooms. Budget constraints and cost-cutting measures can result in choices that are short-sighted and create conditions where air ventilation and circulation systems must be turned off so that students can hear the instructor. This requirement must be communicated to the design engineer to ensure proper air circulation and duct sizing. Often, less expensive high velocity, small duct mechanical systems create noise problems that go undetected until it is too late to correct. Large, oversized ducts create lower velocity and higher air volume so that air is dispersed quietly over the entire room rather than blasting out of small vents.

If low structural ceiling heights prevent large duct work, consider raising the ceiling as high as possible and installing mechanical ducts in the top of the side walls. Side wall duct systems generally limit the distance cool air can be distributed, however, and are used primarily in smaller classrooms.

In rooms with ceiling mounted video projectors, microphones, or other equipment, the duct work needs to allow for installation in the proper location.

Utility Boxes

When classrooms share a common wall, electrical receptacles or other utility boxes should not be installed back-to-back with similar receptacles in the next room. Off-setting the boxes will reduce sound transmission between rooms.

ACCESSIBILITY

Doors

At least one set of entry doors to every facility should be power activated using both a high (approximately 42" above finished floor) and a low (approximately 6" above finished floor) for persons with limited upper body mobility. In some cases, interior doors may also need to be power activated if the door opening pressure is great (higher than 8.5 lbs. force). In many cases, door closures can be adjusted to decrease the door opening pressure. Installation of magnetic devices that hold interior doors open and are connected to a building fire alarm system is another method of providing accessibility.

Accessible Routes and Fire Safety

An accessible route must connect accessible building or facility entrances with all accessible spaces and elements within the building or facility. Accessible routes should also serve as a means of emergency egress or connect to an accessible area of rescue assistance. (Areas of rescue assistance are not required in buildings that have a supervised automatic sprinkler system).

Each area of rescue assistance should contain a method of two-way communication (both audible) and should be marked with appropriate signage. Areas of rescue assistance should be located within a smoke-protected and fire-protected area of egress.

Where audible alarms are required by life safety codes, visible alarms must be provided which signal the same areas that are required to be signaled by the audible alarms.

Signage

Public entities must provide signage at all inaccessible entrances to each of its facilities that directs users to an accessible entry or to a location with information about accessible entities. Tactile maps or prerecorded instructions may be useful to visually impaired persons.

The Americans with Disabilities Act Accessibility Guidelines (ADAAG) gives specific guidelines for the design of raised and braille characters and pictorial symbol signs. The legibility of printed characters is dependent on the viewing distance, character height, ratio of the stroke width to the height of the character, contrast of color between character and background, and print font. Instructions on mounting location and height also are specified in the guidelines. (Section 4.30 ADAAG)

Where permanently installed assistive listening systems are required, signage is needed that indicates the availability of the system, including the international symbol of access for hearing loss.

Environmental Issues

Due to many medical situations, which will be referred to collectively as cardiopulmonary medical problems, fresh air or clean recirculated air must be provided for classrooms. This means that windows and fresh air intakes for the buildings and classrooms should be located away from loading docks, mechanical areas, exhaust vents, roadways, and other sources of potential irritants.

Persons with allergies often have problems with chemical aromas, including carpet glue, paint, and roof tar. Use of these in general classrooms should be minimized whenever possible, and adequate "airing out" time must be provided before rescheduling classes into the rooms.

Flickering of fluorescent lights can trigger seizures in persons with epilepsy and other neurological disorders. Regular inspection and/or replacement of ballasts and tubes can help eliminate this potential problem.

BUILDING SYSTEMS

Lighting

Due to the increased use of media and technology in classrooms, the design of easy-to-use, adjustable lighting systems is more important than ever.

General Lighting

Lighting should be designed in accordance with the Illuminating Engineering Society's and the National Electrical Code's current recommendations. In addition, lighting should be designed to meet the special program requirements for each instructional space. For example, the control of light has become increasingly important as more technology is used in classrooms and lecture halls. Although adequate lighting levels can be achieved through a variety of approaches, it is essential that all instructional spaces have a range of lighting

possibilities, from a comfortable level for reading and seeing the chalkboard to sufficient darkening at the projection screen to accommodate various types of projection while still permitting enough light in the seating area for notetaking.

A general lighting level of 50-60 footcandles should be provided at all student stations within the room and at the instructor area. Although low light levels are often acknowledged as a problem, too much lighting also can create difficulties (e.g. glare, reflection, eye strain, etc.).

Controls

The number of switches required to control the room should be kept at a minimum and should be clearly labeled. Standardization of lighting controls among instructional spaces is recommended. In addition, illuminated switches make it easier for users to locate lighting controls in a darkened room.

Switching for the room lights should be provided at every entrance to the room. In addition, the room lights should be controlled from the teaching station as should any lights that are capable of being dimmed.

Note-Taking/Dimmable Lighting

For notetaking during projection, it should be possible to reduce the lighting to 5-10 footcandles over the seating area with all direct light eliminated from the instructor and projection screen areas. Incandescent lights for note-taking should illuminate between 0 and 20 footcandles.

There continue to be advances in eliminating the flicker of dimmable fluorescent lights, a major problem in the past. Experience at some institutions has shown that while the fluorescents can be dimmed to acceptable levels now, the tubes burn out at twice the rate of tubes in non-dimmable fixtures.

An alternative to dimming all tubes in a multi-tube fluorescent fixture is to separately control the tubes. For example, one switch can be an on/off control for two of the tubes in a three tube fixture. A second switch can control the third tube. In a room with 50 footcandles of light at the student work surface, turning off two tubes can reduce the level to 16 2/3 footcandles. If the third tube is on a dimmer, by dimming this last tube to 50%, the level can be reduced to about 8 1/3 footcandles, well within the guidelines of 5-10 footcandles.

The lighting system in the room should be zoned from front to back so that the entire front zone can be turned off, further reducing the light in the projection screen area of the room.

When lighting is reduced during projection, some type of lighting is needed in the presentation area for the instructor (such as a spotlight or podium light). Special lighting on technology controls or equipment racks also may be needed.

Illumination of walls should be minimized to reduce reflection.

Chalkboard/Marker Board Lighting

Illumination of the chalkboard or marker board should be 10-15 lumens distributed uniformly across the entire writing surface.

If a classroom or lecture hall is designed with a large amount of chalkboard/marker-board, the lights over the writing surface should be controlled in separate sections to permit

illumination of a portion of the board while one projection screen is in use. Proper selection and installation of the board lighting should ensure that the lamps in the fixtures will not be visible to students seated in the front rows. In addition, the fixtures should not interfere with raising/lowering the screen(s).

Ambient Light

Ambient light within the room (from hallways, signage, and other sources) should be controlled so that it is far away from the projection screen and is not a visual distraction. Emergency exit lighting should be self-luminous on a dark background and should conform to code requirements.

Heating Ventilating And Air Conditioning

The circulation of air is a critical factor in all instructional spaces. Poor air circulation causes students to feel drowsy and not alert. Careful selection of duct sizes, air handlers, and fan units can achieve effective combinations of proper air flow and quiet operation of mechanical systems in classrooms and lecture halls.

The heating, ventilating, and air-conditioning (HVAC) system must provide adequate air changes per hour in conformance with current standards of the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE). The recirculation of air within the building should not be done in such a way as to result in hall noise entering the room.

Air ventilation units should not blow a strong volume of air directly on the seating area or on the instructor area. Since it takes very little air flow to cause projections screens to move, there should be no ducts or intakes close to projection screens. The air circulation system in the room should be able to be used at all times separately from any HVAC system that may be operated only seasonally.

The temperature range should be maintained within 68-75 degrees Fahrenheit, with relative humidity at 50 percent, plus or minus 10 percent.

No building should be designed so that the windows and doors are essential for temperature control within the building. Ideally, each classroom should have a temperature-sensitive monitoring device within it and that device should be tied to a central monitoring system maintained and overseen by physical plant staff. Response to abnormalities detected by such a monitoring device should be a number-one priority at all times because of the lack of any other method of circulating air, especially in rooms without windows, such as lecture halls.

The acoustical considerations in determining volume of air-handling noise should include, in addition to the background noise level, any vibration considerations that would generate additional noise. (See Acoustics section, Chapter 2).

Air intakes for classrooms should not be located in or near loading docks, trash receptacles, or areas of high vehicular traffic outside the building. Additionally, air exchanges inside buildings should isolate air circulated in classrooms from air circulated in laboratories and other areas capable of producing odorous or hazardous airborne contaminants.

The system servicing classrooms should operate independently of any system(s) servicing other functions within the same building.

The installation of low-velocity ceiling fans will provide air circulation, an important element in all classrooms, but especially in rooms which are not air conditioned. The mounting location of the ceiling fans must not interfere with projected images or equipment.

Technology can make special demands on the buildings in which it is installed. For this reason, new construction (as well as renovation projects) requires special attention to the design of the electrical and the heating, ventilation, and cooling (HVAC) systems so they will meet the requirements of the equipment that will be installed. This often means specially conditioned or additional electrical circuits, increased number of air exchanges, year-round temperature and humidity control, low-noise ducts and air returns, etc. Renovation of individual rooms can present special challenges, especially when building mechanical systems are not being replaced. In those circumstances, even such simple measures as installing ceiling fans can improve conditions until major renovations can be made.

Routine maintenance of building mechanical, electrical, and plumbing systems is critical. It is particularly important for the HVAC system ducts to be cleaned and the air flow balanced regularly. These measures not only benefit the users, but they prolong equipment life and reduce maintenance costs since many types of equipment are especially sensitive to environmental conditions.

ELECTRICAL AND TELECOMMUNICATION SERVICES

Electrical

All electrical services should be protected from surges and spikes. Electrical outlets should not be controlled from a wall switch that could be confused for a light switch.

New construction or major renovations should make provision for a minimum of 20 percent, with a recommended 40 percent, future increase in the need for electrical services in classrooms. This includes additional capacity in the breaker box for future use.

All wall outlets should be mounted 18-24 inches above the floor. In addition, electrical service (and conduits/cable trays) should be provided in the ceiling for future projection and wireless communication capability.

There should be no elevator motors, compressor motors, blower motors, or other types of equipment on the side of the power transformer that feeds classroom or lecture hall circuits.

Telecommunications

Every classroom should be connected to campus networks for voice, data, and video communication.

There should be one dedicated telecommunications closet of adequate size on all wings of each floor of a classroom facility. Attention should be given to the HVAC needs of these telecommunications closets because of heat generated by the equipment.

The central feed conduit or cable tray from the closet to each classroom should make provisions for voice, data, and video. Anytime an empty conduit is installed, it should contain a pull wire. A wiring box convenient to the hall or other entrance path to the room should be installed in the ceiling with conduit or cable tray to the front and rear center of the room, to each side wall above the ceiling, and from the front to the rear of the room.

All low-voltage connections should be separated from the electrical circuits to the room. The low-voltage services should be isolated from each other through separate conduit. These

services include controls for slide projectors, audio, video, data, and voice feeds. These circuits should not be tied to ground. The slide-projector jack should be installed with the two pins closest together at the top of the jack.

Spare capacity to accommodate future growth should be built into new construction and major renovations. Provisions should be made for networking classrooms within a building, and among buildings if a campus communications backbone is in place or planned.

All conduit, trays, and cabling should be clearly labeled at all termination locations so that a knowledgeable person who has never seen the installation before can identify the services in the room.

Each classroom should be equipped with two-way voice communication capability to a central classroom technology support unit.

To insure compatibility and standardization, the campus should have a wiring standard that is reviewed and updated regularly by appropriate campus units.

TECHNOLOGY

An institution's commitment to provide and support the use of technology in classroom instruction triggers a series of complications to good classroom design. Integrating modern technology into general purpose classrooms and large lecture halls involves more than simply installing the necessary equipment. A host of related issues must be addressed if the technology is to function properly and support instruction in meaningful and appropriate ways.

Central Audiovisual Distribution Systems

Some institutions provide media support through centralized electronic distribution systems to buildings or groups of general purpose classrooms. This approach requires a centralized distribution facility equipped with racks of head-end media source equipment, a wired distribution network, along with remote controls and display devices installed in each classroom.

The general advantages of this approach for media distribution are the standardization of operations and equipment in all rooms and the general elimination of the physical delivery and setup of media gear. In this scenario, maintenance and replacement of broken or obsolete equipment can be arranged on a programmed, life-cycle schedule, and emergency break-downs are kept to a minimum.

The key issues and concerns when deciding whether to adopt central media distribution system include:

- the selection of an electronic control system which provides adequate instructor control of the media usage within each classroom;
- the development and usage of images at the highest quality possible within the classrooms. The goal should be the use of fiber-optic, high-band delivery of digital images to the display devices with the classrooms.
- the provision of technical personnel to adequately support the operation of the centralized distribution system. The institution should also make provision for media professionals needed to manage the system and for training users in the capabilities of the system.

- the requirement of maintenance and repair support for the distribution system. This may include an ongoing relationship with an appropriate vendor.

- the establishment of networking and connections to various information sources outside the local control room and the agency.

- the high cost to purchase and install such a system. Maintaining an older, conventional system may be more cost-effective.

- faculty often don't plan ahead enough and find that delivering their materials for playback ahead of time is inconvenient and does not allow for spontaneous use of materials

In general, the decision to implement a central distribution model, versus a localized distribution model, should be made by each institution and its media support unit after a thorough study of dominant instructional methods, user and presenter preferences, funding, logistics, and overall facility design.

Standardization

The use of electronic technology in the classroom must be as "user friendly" as possible. One way to accomplish this is to establish a standard layout and placement of all control panels and equipment. Standardization facilitates use by faculty who teach in numerous rooms, troubleshooting and maintenance by technical staff, and the interchange of components.

Standardization also reduces training time and costs for both the users and the support staff, and it frequently results in lower equipment prices due to quantity purchases. The location of light switches and equipment and screen controls should be as standard as possible from room to room and each should be clearly labeled. Portable equipment and interfaces that require user hook-up can be made easier if equipment is the same (or similar) and by identifying cables and connectors with labels or color coding.

Security

Security measures include marking, stencil-painting, and engraving equipment (both externally and internally), the use of lock down cables and devices, and systems that connect equipment to centralized alarm systems (e.g. fiber optic loops). Room and building security systems may include such elements as standard door locks that use keys, key cards or keypads; a variety of sound and motion sensors; or surveillance cameras. Teaching stations that house equipment need to be designed to provide for maximum security and at the same time to be convenient to access by the user. Portable equipment should be attached to carts and kept in secure storage closets on each floor or if stored on another floor, access to elevators for transporting between floors is needed. A current inventory process and list is also important for keeping track of hardware and software, and usage of facilities.

Video And Computer Projection Systems

Classrooms should be designed to accommodate both video and computer generated (or electronic) displays. In general, the same room conditions specified for optical projection (light control, screens, sound, etc.) apply to video and computer projection.

Determination of the most appropriate type of display or projection system to use depends on room and audience size, and the type of visual materials used. For showing video, a large monitor/receiver (25"- 40", direct or rear view) is normally adequate in seminar rooms.

while large screen projection devices are most suitable for standard size classrooms and lecture halls. For computer generated materials, a large screen data projection system is usually more effective regardless of room and audience size.

When a monitor/receiver needs to be movable, carefully evaluate equipment for safety considerations. Monitors/receivers mounted on carts tend to be top heavy and can cause serious injury or damage if they are not designed, built, and/or used properly. The International Communications Industries Association (ICIA) has established standards regarding carts used to move portable television equipment to and from classes. It is recommended that these standards be followed. If a monitor/receiver is wall or ceiling mounted, it should be secured and tilted down for easy viewing. If the set is mounted over an aisle, the lowest part of the mount should be at least seven feet from the floor or it can be mounted on a cane-detectable cabinet or rack in the corner. Special attention during installation is needed to avoid glare from lights and windows.

Large screen projection is another option for displaying video materials. It provides a large image that is usually more suitable than the smaller monitor/receiver. Projection systems for standard classrooms can be portable or ceiling mounted. For optimum results, control of natural and artificial light is critical. Window cover must be opaque. Room lights must be designed so the projected image is not washed out by ambient light, and to allow for note taking -- dimmable to 5 to 10 footcandles over the student area.

There are several options for the display of computer generated images -- multi-synchronized monitor/receivers, liquid crystal display (LCD) panels used with a high light output overhead projector, liquid crystal projectors, or high level RGB projectors. The type of unit used depends on room size, the nature of the visual, and the bandwidth frequency of the originating computer. (It is important that the projection system match the bandwidth of the computer or the image will be less than adequate.) If a LCD display panel and overhead projector are used there must be an electrical outlet in the front center of the room, or in the floor ten to fifteen feet from the screen. There must also be a projection distance of ten to fifteen feet from the front wall to the first row of seats. The exact projection distance will depend upon the focal length of the overhead projector lens and the image size required.

Several factors should be considered when mounting a video projector in the ceiling. There must be a grid or beam anchored to the permanent ceiling that is strong enough to support the weight of the projector and, if possible, an elevator lift or pulley system to lower and raise the projector. There must be electrical power and conduit/cable tray running from the ceiling location to the teaching station or location of the video player or computer. Equipment manuals should be consulted as to the appropriate type of ceiling mounts, conduit size to match cable and jack sizes, and projection distances required to meet legibility standards. Conduit will also be needed for sound system equipment for both video and computers.

If the room is designed to use both video and computer generated images it should be possible for the faculty member to easily switch among the various video and computer inputs. Commercially available interfaces and media control systems are available to accommodate this function. The number and type of sources must be clearly defined before purchasing to insure that all can be accommodated. For computer installations it is also important to determine the maximum distance the computer signal will travel before it must be amplified.

Projection Screens

The need for multiple projection screens in classrooms increases as the use of technology in instruction increases. The standard single center screen in the front of the room

is often no longer adequate. There are two common methods of adding a second projection screen to the front of the room. Regardless of the method, screens should be mounted so they do not block access to light switches and other controls or traffic patterns.

Method 1. Hang two screens side by side across the front wall of the instructor area. If this method is chosen, a minimum of six running feet of chalkboard should remain exposed when either one of the projection screens is in use.

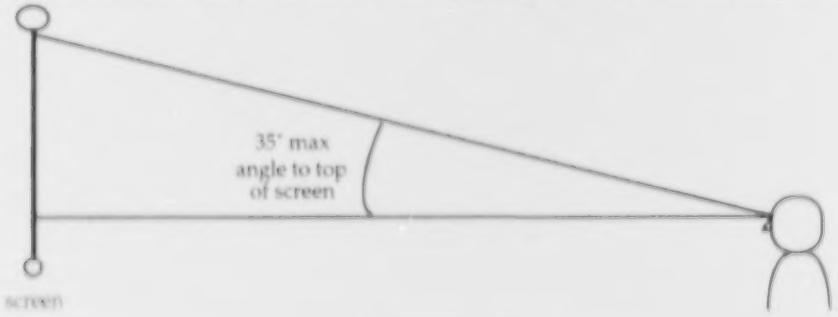
Method 2. Place one screen in the front of the room and the other in the front corner of the room. Once again, if this configuration is chosen, a minimum of six feet of chalkboard space should be exposed when either one of the projection screens is in use. An effective corner screen is a rigid-frame tilt screen, sized specifically to meet the needs of overhead projection.

The most suitable projection screen surface is a matte white finish. This surface, which provides a viewing angle up to 45 degrees to each side of the center line of the screen, accommodates the widest range of room seating arrangements.

Screens mounted parallel to the front of the room should be mounted with the top of the screen 10 to 12 inches out from the wall to allow clearance over chalkboard lights and map hooks. This distance also provides a means of correcting keystoning (distorted image that frequently results when using an overhead projector) since the bottom of the screen can be pulled back to the wall with a tieback. In a non-tiered room the screen must be mounted high enough so that the bottom of a lowered screen is about 45 inches above the floor. In larger tiered lecture halls the bottom of the lowered screen should be no lower than the top of the chalkboard. The screen should not be located near an air exhaust/intake duct since air flow can cause the screen to move.

The size of the projection screen is determined by the room size. Screen width size is determined by using the 1 : 4 ratio -- distance of the farthest viewer divided by 4 equals the screen width. (e.g. in a room where the farthest viewer is 40 feet, a 10 foot wide screen is needed). This formula provides a screen large enough for the use of electronic projection of video and computer images because of their 12.5 to 25 percent lower resolution than optical projection. This lower resolution results in a loss of sharpness in edge definition of the image. This is particularly critical for computer image projection which is often comprised of text. The first row of seats should be no closer to the screen than twice the width of the screen.

The top of the screen should subtend an angle no greater than 35 degrees from the horizontal from any seating position. However, some compromises may have to be made in the first few rows of seats to allow sufficient space for chalkboard/markerboard and a reasonable screen size, and yet not have the front seats too far from the front of the room.



Front Screen Or Rear Screen Projection

Front projection screens are recommended over rear projection screens for general purpose classrooms, lecture halls, and seminar rooms. Front projection:

- accommodates a wide variety of projection equipment, including overhead projectors
- costs less to purchase and install
- provides higher resolution, better color fidelity, and better contrast ratios (when used under appropriate lighting conditions)
- requires smaller projection booth size (or none at all)
- provides easier access to and operation of equipment

Though not generally recommended, rear projection has some advantages for certain types of installations, such as conference or board rooms. Advantages of rear screen projection include:

- provides better rejection of ambient light
- allows higher levels of room lights making it easier to take notes and see the presenter
- lets presenters walk in front of the screen without blocking the projected image or having the projected light shine in their eyes
- provides a more seamless, less noticeable technology environment

It should be noted that if projectors are installed in a rear projection booth behind the instructor area, the booth must be deep enough or a mirror system may be required to achieve the correct throw distance for the projector.

Computers

How to handle the use of computers and their peripherals in classrooms requires careful thought and evaluation. One common approach is to install computers permanently within instructor consoles and connect them to installed video projection systems. At the other end of the spectrum, computers and projection panels are rolled into classrooms as needed. Some key issues to examine when determining the best approach include:

- usage level of computers in instruction
- space and budget for consoles
- costs of computers and interfaces
- availability of technical support personnel for individual classrooms
- standardization of hardware and software
- mobility needs and instructional approach of faculty
- security

CHAPTER 3
GENERAL PURPOSE CLASSROOMS

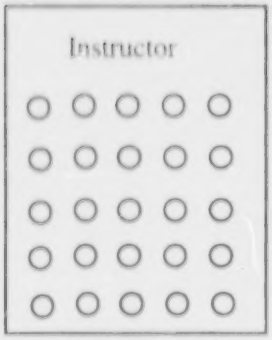
INTRODUCTION

As stated in the Introduction, General Purpose Classrooms are defined as those seating 20-75 students and having at least 350 square feet of space. These rooms are by far the most numerous on most campuses and yet they often are taken for granted by users as well as classroom planners. It is important to realize, however, that well-designed classrooms are a critical factor in creating the appropriate environment for effective classroom instruction.

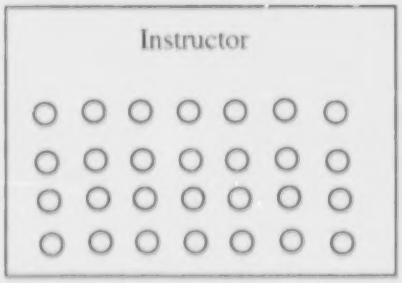
DIMENSIONS

Classrooms should be designed so that the length is approximately one and one-half times the width of the room. Rooms that are wider than they are deep normally present unacceptable viewing angles for projected materials and for the chalkboard. With increased use of projected materials, especially computer imaging, the shape and dimensions of classrooms are more critical than ever before.

The instructor area should be along the narrow wall of the room.



YES



No

There should be no obstructions (such as columns or posts) anywhere in the classroom. The front wall (including thermostats, lights switches, etc.) of the room behind the instructor area should have no protrusions into the room so that a chalkboard/ marker board can be installed across the entire wall of the instructor area.

Ceiling heights will vary depending upon the size of the room. The following are suggested minimum ceiling heights:

MINIMUM CEILING HEIGHTS

Room Capacity	Flat Floor	Sloped or Tiered Floor
20-49 stations	12 feet clearance	not recommended
50-75 stations	12 feet clearance	10 feet in rear, 12 feet in front

Clear space should be provided above the ceiling, away from mechanical and utility systems to permit installation of electrical and telecommunication system upgrades and structural supports for projection equipment installation.

The decision to select flat or sloped/tiered floor surfaces often depends on the cubical dimension of the space. Rooms with low ceilings may seem cramped or have poor sight lines for projected images if the floor is sloped or tiered. The instructional activity also should be an important factor. Classrooms with flat floors provide greater flexibility when classroom activities involve collaborative learning projects or small group discussions while rooms with sloped or tiered floors may provide better sight lines for students, especially in larger general purpose classrooms (60+ seats). For these larger rooms, there should be an entrance at the lower end of the slope (i.e., the instructor's area) to provide access for equipment carts and people who use wheelchairs.

ENTRANCES

Rooms with fewer than 50 stations normally should have a single entrance/exit. If achieving maximum room capacity is an objective, a single entrance at the front of the room will usually provide room for more student stations because entry space is incorporated into the instructor area. However, single entrances from the rear of the classroom reduce the disturbance caused by students arriving late for class. If only one entry is possible, it should be located at the front of the room. To facilitate movement of people and equipment, two entrances are preferred, especially in rooms with 50-75 capacity.

All doorways should facilitate the easy passage of people with disabilities and should accommodate moving equipment into and out of the room.

WINDOWS

If used, windows should be placed away from walls that are near parking lots, exhaust fans, vehicular and pedestrian walkways, and building cooling towers. Many factors, including anticipated types of instructional activities and projected use of audiovisual materials, should be considered to determine whether to include windows in new construction and where to place them when used.

The two primary purposes of classroom windows are aesthetic and environmental. The presence of windows in a room provides visual contact and sensory stimulation with the world outside. All windows in classrooms should be operable so that they can be opened to provide additional air circulation when needed, particularly when the building heating, ventilating and air-conditioning system is not operating adequately. Windows should either raise and lower or open outward (never inward).

The advantages of windowless classrooms include the ease of light control, the elimination of heat loss or gain during periods of extreme temperatures, and the elimination of noise interferences from traffic or other exterior sources. There may be special circumstances where windowless classrooms are desirable.

Architectural design often requires that the exterior of a building has windows. This requirement can be met by locating windows in other spaces (lobbies, hallways, offices, etc.) rather than in classrooms.

Any classroom that does not have windows must be air conditioned and must contain adequate circulation and outside air exchange. In addition, if there are no windows, extra care

must be given to the use of interior finishes, colors, and decor to provide visual interest to the room.

When windows are installed, particularly on the south side of the building, install tinted glass with a "low E" rating to reduce the heat transfer from the outside to the inside of the room. Double, or even triple, glazed windows will assist in reducing heat transfer and will provide a noise insulation barrier from exterior sounds.

When windows are a desired feature in classroom design, the glass surface should be limited to minimum amounts. All window surfaces should be at the side of the room and not located in the front or rear of the room. The use of clerestory and other types of window panels that admit incidental light should be avoided.

WINDOW TREATMENTS

Window treatments should be opaque and should be capable of eliminating all outside light from reaching the projection screen(s). Several common types of window treatments and their characteristics are described below. Given that each type of treatment has unique advantages and disadvantages, consider using a combination of window treatments, such as blinds and shades, to achieve a better range of light control.

Horizontal Blinds

If horizontal blinds are used, the slats should have a nonreflective matte finish. Additional light control is achieved when horizontal blinds are installed with channels to provide a light-tight abutment to the window frame. It should be noted, however, that horizontal blinds, even those with channels, will not provide sufficient room darkening for electronic projection.

General maintenance is a concern wherever horizontal blinds are installed, especially those in channels, because they require more frequent cleaning and contain more mechanical parts than other window treatments. In some cases, the installation of horizontal blinds between glass window panes works effectively to block outside light; however, the operation and repair of horizontal blinds inside windows can become a maintenance problem.

Shades

Opaque roller blinds offer significantly more light control than horizontal blinds, particularly if the roller blinds are installed with channels to prevent light leakage around the edges. While somewhat less expensive to install than other types of window treatment, roller blinds do require more maintenance and need to be checked by the custodial staff on a regular basis to prevent permanent damage.

Vertical shades or blinds do not provide adequate light control for use in the classroom.

Snug-fold, or accordion, shades that overlap the window opening provide excellent room darkening. They fold up easily, gathering at the top of the window when natural light in the room is desired. Fire retardant vinyl coated fiberglass material is recommended. Tie hooks should be provided to allow a range of adjustment and a method to manage extra cord length when in the open position.

Draperies

Draperies which are opaque provide better light control and, when properly installed, normally require less maintenance than either horizontal blinds or roller blinds. Drapes, like blinds, need to be cleaned periodically. The installation of drapes should be done with cord

tighteners for ease of operation. Install commercial grade drapery rods for durability. Drapery material must be fire retardant.

FINISHES

Walls

A chair rail should be installed on side and rear walls whenever movable seating is used in the room. The surface below the chair rail or chalkboard should be extremely durable, such as epoxy paint or vinyl wall covering. All surfaces must be washable. The finishes used in a classroom should be chosen with the room's acoustical characteristics in mind. (See Acoustics section in Chapters 2 and 4.) Accent colors or design elements should be used to provide visual interest to the room.

Ceilings

For direct lighting, ceilings should be a light color and nonreflective. For indirect lighting, a higher reflective material is required. (See also section on acoustical characteristics of the ceiling.)

FURNISHINGS AND EQUIPMENT

A number of factors should be considered when selecting classroom furniture.

Instructor Area

A sturdy table or desk with a modesty panel should be placed at the front of the room as part of the instructor area. This area also should include either a tabletop or free-standing floor podium with a minimum surface of 18 x 24 inches. For universal access, use a height-adjustable podium or a combination of table and podium. There also should be a stool or chair available at the teaching station. This furniture should be coordinated with the other furniture in the room.

Chalkboards/Markerboards

All general-purpose classrooms should have chalkboards or marker boards across as much of the instructor area wall as possible. The installation of boards on the side or rear walls should be determined by the programs that will use the room and the viewing angles of the students.

The chalkboards/markerboards should be mounted with the bottom edge of the tray 36 inches above the finished floor. The boards should be four feet in height and have trays under the full width of the board. Seams on the chalkboards/markerboards should be flush. The surface of the chalkboard should be black to provide maximum contrast with the chalk being used.

While markerboards eliminate chalk dust, markers are more expensive and only those made for markerboards should be used since others can permanently damage the markerboard surface. In addition, markerboards should not be used as projection screens.

Refer to the Lighting Systems section of Chapter 2 for a discussion of lighting the chalkboard/markerboard.

Tackable and Display Surfaces

A tack-strip approximately two inches wide should be placed above the chalkboard and map hooks attached to the tack strip or the top of the chalkboard. There should be nothing larger than a tack strip above the chalkboard/marker board inside the classroom. A tackboard in the hall, convenient to each cluster of classrooms, should be used to post student

announcements and other types of general information. In addition, a tackboard or tack strip should be installed outside of each classroom in the immediate vicinity of the doorway so that grades and other class related items may be posted.

Student Seating

When determining the seating capacity of a room (regardless of which type of student furniture is used) an additional 50 square feet should be allowed for the teaching station. For a multi-media or other specialized classrooms, 100 square feet or more may be needed for the instructor area. To calculate the correct number of student stations in a room, take the total square footage of the room, subtract the square footage for the teaching station, and then divide by the number of square feet per type of seating (i.e., movable seating, tables and chairs, or fixed seating).

Room Capacity = Total Sq. Ft. - 50 sq. ft. instructor area X Station Factor

TYPE OF SEATING	STATION FACTOR
movable tablet armchairs	15 sq. ft.
tables and chairs	20 sq. ft.
fixed seating w/ folding tablet arms	15 sq. ft.
theater fixed seating w/ folding tablet arms	13-15 sq. ft.

Movable Seating

Classrooms under 50 capacity should have movable seating unless there are special considerations. When using movable tablet armchairs, a minimum allocation of 15 square feet per student is recommended, which includes the seating area and the aisles.

The tablet arms should contain at least 150 square inches of writing surface. While larger tablet arms are desirable, such factors as durability, weight, and stability also must be considered. Both the tablet arm and the chair should be durable material and comfortable. Ease of maintenance and availability of spare parts should be major considerations in the selection of all types of seating. For example, field replaceable parts eliminate transporting seats to a repair shop. An adequate supply of spare parts should be included when new chairs are purchased.

Tables and Chairs

Tables and chairs are desirable because of the additional work space provided to students. However, this arrangement reduces the student seating capacity of the room because it takes approximately 20 square feet per student station to seat students with tables and chairs, compared to 15 square feet for regular student desks. In general, tables used in classrooms should be 18-24 inches deep. Deeper tables will increase station size and reduce seating capacity. It may be determined that tables should have linking capability when joined. If so, be sure that work-surfaces join evenly. Bases should have adjustable glides for leveling. A pvc edge is more durable than a self-edge. The type of table legs and their placement will have an impact on how many students can sit comfortably at each table.

Fixed Seating

Rooms of 50-75 capacity should be evaluated on the basis of intended use to determine whether fixed or movable seating should be installed. If the classroom floor is sloped or tiered, fixed seating is usually required.

When using fixed seating with a folding tablet arm, 15 square feet per student station (not including the instructor area) is appropriate. This allows space for the seating area and aisles.

The writing surface on the folding tablet should be at least 150 square inches. Using a variety of seat widths will permit maximizing capacity. Wider seats should be located on the aisle.

Seating for Left-Handed Persons

Both movable and fixed seating should contain a minimum of ten percent left-handed tablet arms or should contain chairs designed to be used by either right- or left-handed people. The left-handed seats in fixed seating arrangements should be along the left side of the aisle when viewed from the instructor area.

Movable seating can be purchased with sufficiently large writing surfaces that are suitable for both right- or left-handed students.

Seating for Persons with Mobility Impairments

Stations for students with mobility impairments, especially persons who use wheelchairs, should be provided at approximately four percent of the capacity of the room. In addition, one percent (at least one seat of all fixed seats in rooms of less than 100 capacity) should be aisle seats with no armrests on the aisle side. (See APPENDIX A, Designing For Accessibility). These stations should be available in a variety of locations within the seating area. To accommodate students using wheelchairs, a table that provides knee space of at least 27 inches high, 30 inches wide, and 19 inches deep should be provided. Another options would be to provide adjustable height tables that adjust from 28 inches to 34 inches above the finished floor. In addition, provisions may be necessary to accommodate companions who assist students with hearing, sight, and mobility impairments.

Trash and Recycling Receptacles

Trash and recycling receptacles should be available near the door of each classroom. Receptacles should have a large opening and be large enough to accommodate trash generated between scheduled collection times.

Pencil Sharpener

It is recommended that a pencil sharpener be conveniently located in or near each classroom and be securely mounted with tamper-resistant screws.

VOICE AMPLIFICATION

Voice amplification should be considered in rooms of 50-75 capacity. The decision should be based on outside noise factors, the acoustical characteristics of the room, and any special needs. (See APPENDIX A, Designing For Accessibility)

PROJECTION

See Chapter 2 for a discussion of projection requirements.

ACCESSIBILITY

Classroom design must insure that the room be accessible to persons with disabilities. Essentially, each classroom should have the following characteristics.

- An accessible route into the classroom is required; thresholds (not to exceed 2 inches), stairs, or other barriers should be minimized.
- In the instructor area, teaching platforms, if required, must be accessible by means of a ramp; teaching equipment and room controls also should be accessible.
- Wheelchair stations must be provided so that persons with disabilities are provided a choice of sight lines that is comparable to those provided for persons without disabilities.

- Doorways and aisles must be sufficiently wide enough to allow wheelchairs to pass easily (32" clear minimum, 36" recommended).
- Door hardware should be lever-operated, push-type, or U-shaped to allow easy operation and the force required to push or pull a door should be minimized (i.e., maximum 5 lbf, pounds of force, for interior doors). The minimum maneuvering clearance at the pull side of a door is 18 inches.
- Room identification signage should be mounted 60 inches above the finished floor to the centerline of the sign. Characters should be raised, should contrast with the background, and should accompany Grade 2 Braille lettering.

See APPENDIX A for a more complete discussion of accessible design.

LIGHTING SYSTEMS

See also the section on Lighting in Chapter 2.

General Lighting

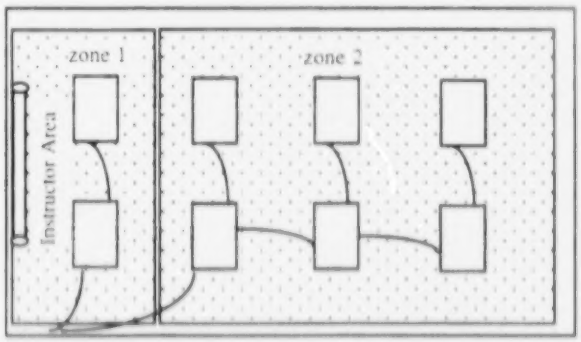
The control of light in a general purpose classroom has become increasingly important with the growing use of technology. While adequate lighting levels can be achieved through a variety of approaches, it is essential that all instructional spaces have a range of lighting possibilities, from a comfortable level for reading and seeing the chalkboard to sufficient darkening at the projection screen to accommodate various types of projection while still permitting enough light in the seating area for notetaking. Selection of lighting systems should meet program requirements while achieving energy efficiency.

The room lights should provide 50-60 footcandles at each writing surface, including the teaching station. Diffusers used in ceiling fixtures should be nonreflective. General lighting should be uniformly distributed throughout the room. Excessive illumination can be as debilitating to students as too little illumination.

Controls

All switching should be kept simple, with the user in mind. Light switches should be clearly labeled as to function. Standardization among rooms is recommended.

To accommodate projection needs, room lights should be switched by zone, with the zones being parallel to the screen. At least two zones are needed, one for the projection screen area at the front of the room and the other for the seating area.



All automated light control systems should provide for a manual override.

Note-Taking/Dimmable Lighting

To provide low light in the seating area so that students can take notes during projection, two approaches are commonly used in general purpose classrooms. In both approaches, the front zone near the screen is turned off. For rooms with incandescent lights, dimmers work well and provide excellent control of the lighting levels. With fluorescent lights, controlling individual tubes within each fixture provides the ability to lower light levels (i.e. turning off two of three tubes in a three tube fixture).

ELECTRICAL AND TELECOMMUNICATIONS SERVICES

The number of electrical outlets in the room will depend in part on special functions that may be assigned to the room. In general, rooms below 50 capacity should have a single duplex outlet in each side wall of the room, one fourplex outlet in the center of the rear wall of the room, and three outlets in the front of the room (one fourplex outlet located in the center of the front wall and one duplex outlet near each corner).

In rooms of 50-75 capacity, there should be two outlets evenly spaced in each side wall, three fourplex outlets in the front wall, and two fourplex outlets in the rear.

All wall outlets should be mounted 18-24 inches above the floor. In addition, electrical service (and conduits/cable trays) should be provided in the ceiling for future projection and wireless communication capability.

All classrooms should be connected to campus networks for voice, data, and video communication (see Chapter 2).

CHAPTER 4
LECTURE HALLS

INTRODUCTION

The three fundamental requirements outlined in the introduction to this book (to see all visual material, to hear without noise or distortion, and to be physically comfortable) are especially important in lecture halls. The complexities of good classroom design increase as classroom size increases. Large lecture halls require more entrances and exits, larger projection screen images, good voice amplification, more complex lighting and audiovisual control, special acoustical design, and greater control of the environment by the instructor. Mistakes and minor problems that often occur in small classroom design are magnified in lecture halls because of the fixed environment and more limited range of instructional approaches.

The issue for many colleges and universities is not whether to teach large classes, but how to create a good learning environment for such classes. Effective classroom instruction can be conducted in large class settings, if the room is designed and equipped properly and if appropriate training and support services exist.

National classification standards (e.g., HEGIS and CIP) define large lecture halls as any classroom with more than 50 seats. As stated earlier, our focus on design and size characteristics alters the standard definition so that a lecture hall is defined as a classroom with seating for 75 or more persons.

As mentioned in Chapter 2, lecture halls should be located on the ground floor near entrances to facilitate the movement of students in and out of the hall.

LOBBY AREAS

Lobby space is an integral part of lecture hall design because of the need to accommodate waiting students. This lobby space should be large enough to allow students to congregate without interfering with the normal traffic flow of students entering or leaving the facility. Also, if the lobby will be used for special events, such as receptions and social gatherings, then lobby areas should be designed to accommodate the large groups in a reception style setting. If the lobby area serves primarily as a gathering and waiting area for students who arrive for class, then the lobby area should be sufficiently large enough to accommodate the passage of students attending consecutive class sessions.

Seating in the lobby area is necessary, and should be placed away from the entrance/exit to the lecture hall to avoid any noise interference caused by normal student interaction. Seating also should be selected with durability in mind and, whenever possible, should be integrated into the overall structure of the building, rather than as stand-alone furniture pieces.

The surfaces and finishes in the lobby area, including the floor and the lower portion of the walls, should consist of durable materials that will survive the large volume of student traffic in the area. The upper portion of the walls (above seven feet) should include acoustic materials to dampen noise in the lobby area.

The lobby area is one of the most visible and heavily used portions of the building. For this reason, the aesthetics of the lobby become an important interior design consideration. However, pleasing aesthetic design should be balanced against the practical need for durability.

DIRECTIONAL SIGNS

Signage in and around a lecture hall should be kept at a minimum and should be incorporated into the design of the lobby and the lecture hall when the facility is designed. See Chapter 2, Signage.

There should be no tackboards or other surfaces inside the lecture hall although a tackboard should be installed outside each lecture hall in the immediate vicinity of the doorway so that grades and other class-related items can be posted conveniently.

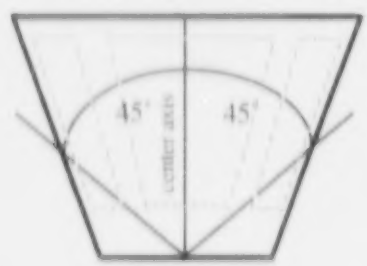
Information should be posted both inside and outside each lecture hall regarding how to report problems with physical facilities and equipment in the lecture hall.

It is essential that information about emergency evacuation of the facility be prominently displayed in the immediate vicinity of the lecture hall.

DIMENSIONS

As the size of the space increases, the complexity of design for that space increases geometrically. It is not a linear process. Design mistakes that may go unnoticed in a small seminar room will be magnified many times in large lecture halls to the point where the space may become dysfunctional.

To provide good sight lines and acoustics, lecture halls should be a modified fan-shaped design. Student seating can be arranged up to 45 degrees off the center axis of the room to provide good viewing angles from all seats. The depth of the room should be no greater than one and one-half times the width of the room, measured at the midpoint of the seating area.



screen

The slope of the floor in a lecture hall should be no more than 1:12. ADA guidelines state that if a slope extends 30 feet, an appropriate size (flat) landing area must be provided for persons who use wheelchairs. If there is a rise of four inches or less from one row to the next, then the seating in each row should be offset to permit clear visibility to the front of the room. The slope of the floor in a lecture hall should maximize sight lines. An accessible route within the lecture hall and a choice of wheelchair seating locations are required (see Furnishings).

Some small lecture halls (under 100-student capacity) may have a sloped or tiered floor while some may have a flat floor. If the floor is flat, a teaching station platform may be installed in the front of the room to improve sight lines between the instructor and the students. In most cases, a six-inch high platform that is wheelchair accessible and large enough to accommodate furniture and equipment for the instructor is sufficient.

The aisles in a lecture hall should be arranged to provide the maximum prime viewing locations for the audience. Generally, this will mean no center aisle. Building codes must be

consulted to determine the number of seats in a continuous row and the distance between rows allowed in the jurisdiction.

There must be no posts or other obstructions anywhere inside a lecture hall that would block the view of the teaching area from any seat.

Ceiling heights will vary, depending upon the size of the room, if the lecture hall will have video projectors that are ceiling mounted, etc. The following are recommended optimum ceiling heights, based on the number of student stations within the lecture hall and the appropriate projection viewing guidelines. These guidelines include:

- the screen having an aspect ratio of 4:3
- the bottom of the screen being at the top of the chalkboard
- the distance from screen to farthest viewer being no more than four times the screen width
- the distance from screen to first row of seats being no less than two times the screen width

OPTIMUM CEILING HEIGHTS

Distance to Last Row	Rear of the Lecture Hall	Front of the Lecture Hall
50 feet	10 feet	17 feet
75 feet	10 feet	22 feet
100 feet	10 feet	28 feet

For acoustical purposes, walls in lecture halls should not be parallel and should have a rough or textured surface.

ENTRANCES

At-grade access should be provided to the front area of large lecture halls which have sloped or tiered floors to move equipment into and out of the room and to accommodate people who use wheelchairs. In lecture halls where there is a sloped or tiered floor, the floor must remain flat at least five feet from the entrance into the room.

Primary entries for large lecture halls should be in the rear section of the room, with doors placed in the side walls rather than the rear wall whenever possible. This reduces the amount of light reaching the projection screen when the doors are opened during class. Another solution is to use light traps, two sets of doorways that trap light from entering into the lecture hall when the doors are opened.

There should be double doors at each entrance, with each door being a minimum of three feet wide. If it is necessary to have a center post between the doors, it should be removable to facilitate the passage of large pieces of equipment.

It is important that the doors swing open into the lobby area in a way that does not obstruct the efficient flow of traffic to and from the lecture hall. When possible, doors should be recessed into the room.

WINDOWS

All lecture halls should be completely free of windows except for the vision panels in the doors. In remodeling lecture halls with windows, several options exist for handling windows. Some type of light blocking window treatment, such as automatic snug-fold (accordion) black-out shades, can be installed over the windows. Controls to open and close the shades should be located in the instructor's area.

To preserve the windows as an exterior architectural element while permanently blocking the light is another approach. This can be done by replacing glass panes with mirrors or other opaque material or by permanently covering the entire window opening on the inside with some type of decorative/acoustic panel.

FINISHES

For information on color and reflectance values, refer to Chapter 2.

Floors

Resilient, nonskid vinyl or rubber tile is a good choice of floor covering for lecture halls. If carpeting is used, it should be installed only in the aisles, entry, and instructor area, not in the student seating area. In lecture halls where science demonstrations occur, tile should be used in the instructor area. Because it is difficult to prohibit students and faculty from bringing food and drink into classrooms, only industrial grade, stain resistant carpet should be installed since it is easier to maintain and clean. If carpet is used, its effect on the acoustics of the room should be considered.

Walls and Ceiling

Walls should be constructed of a durable material that is easy to maintain and should be basically acoustically non-absorbent except in those areas of the lecture halls where acoustical treatment is prescribed. The ceiling in a large lecture hall is an important factor in the overall room acoustics. For more details, see pp. 39-40.

The ceiling should be a neutral factor in the lighting scheme of the room, projecting a light color from nonreflective material.

It is recommended that both the floor treatment and the wall treatment be in light colors with textures and designs used to add visual interest to the room.

FURNISHINGS AND EQUIPMENT

Instructor Area

As the use of media in instruction increases, particularly in large group instruction, a table and lectern are no longer considered adequate furniture for the teaching station in a large lecture hall. Media needs dictate the installation of a teaching podium at the front of the room that serves as the master control center for the room. Instructors in wheelchairs should be able to access any controls provided in the podium.

The podium should provide access to a variety of communication and control capabilities, including electrical outlets; voice, video, and data outlets; controls for the lights and the projection screen(s); controls for the voice amplification system, including a microphone; and controls for all equipment built into the room, projection booth, or equipment closet.

The dimensions of the podium for a lecture hall should be 24 inches deep with the width determined by the equipment and controls to be housed there (36 inches is optimum). Ideally,

the podium should be adjustable in height. If it is a fixed height, the height should be no more than 42 inches from the floor.

The size and placement of the podium are critical. Neither the podium nor the faculty member standing at the podium should block students' view of the projection screen(s) or the chalkboard/markerboard. If an overhead projector is to be used, it should be able to be positioned close to the podium and at a sufficient distance from the screen to provide an acceptable image size.

If the podium is to contain equipment that is permanently housed in the room, then it should be constructed of materials and using methods that provide the maximum security for the equipment housed within the podium.

The chair or stool for the instructor should be of adjustable height in order to make it convenient for the instructor to use all types of teaching devices.

A telephone or voice communications device, connected to the service unit on campus assigned to provide emergency support to the classrooms, should be located either in the podium or in the immediate vicinity of the teaching station.

Storage and Preparation Areas

Consideration should be given to providing secure storage in the immediate vicinity of a lecture hall where instructors can keep materials needed on a repeated basis as well as provide space for the preparation of lecture materials.

Equipment Storage

Adequate and secure storage for all types of instructional equipment must be provided inside, or in the immediate proximity of, the lecture hall. This storage should be accessible from the hallway and not require entering another classroom for accessibility.

Chalkboards/Markerboards

Special attention should be given to the amount of space available at the instructor area for chalkboard/markerboard and for other visual presentations. The emphasis, particularly in large lecture halls, should be on the use of projection tools in the place of the chalkboard/markerboard in order to provide for maximum visibility to students throughout the lecture hall.

There are circumstances when a chalkboard/markerboard is essential to effective use of the room and should be permanently mounted in the lecture hall. An alternative to mounting a chalk or markerboard to the wall is to purchase a portable writing surface (on wheels) that can be moved in and out of the room as needed and can fold flat for storage.

If a board is to be wall-mounted in a lecture hall, see Chapter 2, Lighting Systems, for recommendations on lighting the boards.

Student Seating Area

Fixed Seating

There may be special circumstances when a small lecture hall, 75-100 students, would best be served by the use of movable seating, but in general it is recommended that rooms seating more than 75 have fixed seating. The seating plan should support the anticipated function.

Continuous fixed tables with attached swing-away chairs are one option in lecture halls. This provides the student with the maximum work area. In addition, by removing the swing-

away seats in appropriate locations, easy access can be provided for wheelchair users or for larger students using straight chairs. It should be noted, however, that it is necessary to allow 16-20 square feet per student station when installing this type of furniture as compared to the requirement of 13-15 square feet per student station when other types of fixed chairs are used. Other options include tables with task chairs on casters and auditorium seating with tablet arms.

When fixed chairs with tablet arms are used, the tablet arm should have a minimum of 150 square inches of writing surface. The arm also should fold to facilitate passage of students through the rows of seats. If fixed chairs are attached directly to the floor, exposed bolt heads should be covered.

Since the number of seats in each row and the relationship of this number to the aisles is often covered by code requirements, these should be consulted in determining the layout of a room. To protect the wall surfaces from damage, fixed seating should not be located adjacent to walls, especially walls having acoustic panels.

It is recommended that all components of seating carry a minimum five year manufacturer's warranty. Further, the manufacturer should warrant the availability of replacement parts for a minimum of ten years.

Seating for Left-Handed Persons

When installing fixed seating, a minimum of ten percent left-handed tablet arms is needed. These left-handed seats should be installed on the left side of the aisle when viewed from the instructor area.

Seating for Persons with Mobility Impairments

Seating for mobility-impaired students should be provided in all lecture halls in accordance with federal and state accessibility codes relative to the capacity of the room. Wheelchair stations should be available in a variety of locations within the seating area. In addition, one percent and at least one of all the fixed seats should be aisle seats with no armrests on the aisle side. To accommodate students in wheelchairs, a table 19 inches deep, 31 inches high (with 29 inches clearance), and 36 inches wide is recommended. (See APPENDIX A, Designing For Accessibility). Provisions may be necessary to accommodate companions who assist students with hearing, sight and mobility impairments.

Trash and Recycling Receptacles

Nonflammable trash and recycling receptacles should be included in the lobby area of the lecture hall and not be made a part of the lecture hall itself.

Pencil Sharpener

One or more pencil sharpeners should be securely mounted with tamper-resistant screws near the instructor area of the lecture hall and within easy access for students.

AUDIO SYSTEM

Voice amplification should be installed in all lecture halls. The microphone and volume control for the amplification system should be easily accessible to the instructor. Other settings, such as tone and balance, should be available only to a technician.

Where technically feasible, a wireless microphone should be installed with the voice amplification system to allow the instructor the maximum flexibility of movement throughout the lecture hall.

Unless a technician is assigned permanently to support instruction in the lecture hall, a sound system separate from the voice amplification system should be installed to handle other sound sources. The system should be capable of amplifying the soundtrack of films, audiotape, and other audio sources such as compact discs, videotape, video discs, and voice coming in via telephone lines. Distribution from the system can be fed into speakers properly mounted on either side of the instructor area or a series of ceiling speakers spaced according to the manufacturer ' s recommendation to provide total coverage within the lecture hall.

See also, APPENDIX A, for a discussion of assistive listening systems for hearing impaired.

PROJECTION

Projection Booth

When appropriate, lecture halls should have a projection booth constructed in the rear of the room. At this time, 16-mm movie and slide projection are still used in classrooms, and a projection booth provides sound separation between noise of the machine and the audience. The minimum size of the projection booth should be 48 square feet. The wall between the projection booth and the lecture hall should have a window whose lower edge is a minimum of 48 inches above the floor, above the heads of those seated in the last row of seats next to the window. This window should be angled approximately five percent off vertical to reduce reflections, with the bottom being the extended section.

A shelf should be mounted directly beneath the window and should be just below the bottom edge of the glass. The shelf should be hinged so that it can be folded down and should be divided into two sections so that each section can be folded independently of the other. Several conveniently located electrical outlets are needed near the shelf.

There should be a speaker to monitor the house audio system, including a voice-amplification system, in the projection booth. The booth should contain a work light designed so as not to shine into the lecture hall. The booth also should include controls for audio, lights, screens, and other built-in projection equipment.

The booth should have adequate ventilation, including temperature and humidity control. The exhaust system should not have a direct connection to the lecture hall.

Security is a major concern, given the amount of equipment installed in most projection booths. All doors should have locks and consideration should be given to additional measures, such as alarm systems or lockable storage cabinets.

The booth should have two doors. A door from the hallway is needed to move equipment in and out of the booth. That means the door should be a minimum of 36 inches wide with no obstruction on the floor. A door from the lecture hall into the booth is needed so the instructor can enter the booth from the lecture hall.

Today ' s technology is transforming many projection booths to multi-media prep rooms, where many different media sources may be controlled. The space required for this type of support space may exceed 200 sq. ft., rather than the 48 sq. ft. the traditional projection booth might measure.

Equipment Closets

Increasingly, users find it more convenient to have equipment at the front of the lecture hall where it is more convenient to the instructor. Equipment closets often house equipment in

racks. If slide/video or film/video converters provide adequate image quality, these also can be housed in a front equipment closet instead using conventional projectors from a booth at the rear of the room.

Auxilliary Input Panels

Faculty often want to bring in equipment that may not be used frequently enough to warrant its being permanently installed in a room. An auxillary input panel is needed (with clearly labeled connectors) which makes it easy for faculty to interface additional equipment with the other systems in the room.

Projection Screens

Lecture halls often require multiple screens, the exact number and size being determined by the design of the facility and by the special uses for the facility. The minimum recommended number of screens is two single or one double width screen. These should be mounted above the chalkboard if the design of the lecture hall permits with the bottom of the screens being level with the top of the chalkboard. The exact mounting height must take into account a variety of factors (ceiling height, how steeply the seats are tiered, etc.) to insure appropriate viewing angles. If two screens are used, one should be placed so that at least six feet of chalkboard/marker board can be used when the other screen is in use.

All screens should be motorized, with switches located both in the front of the room and in the projection booth. This provides control at either location at all times. All switches should have an automatic shut off and all should automatically return to neutral when the screen is fully extended or fully retracted. See also Chapter 2, Projection Screens.

Video and Computer Projection Systems

See Chapter 2, Video and Computer Projection Systems, for a complete discussion of projection.

ACOUSTICS

Acoustics are one of the most important features in good lecture hall design. All surfaces in the room should be studied, shaped and tested integrally with the design of the floor plan so that amplified voice systems will augment, not replace, the natural voice volume. Acoustical consultants offer valuable services in lecture halls design and the services of an acoustics expert are cost-effective when consideration is given to the consequences of poor design. Do not depend on the advice of an audio manufacturer's representative.

Proper acoustical design will isolate the facility from exterior noises and control the background noise level in the room (e.g., mechanical systems noise). Ambient sound levels measured at four feet above the floor at all points throughout the room should have a Noise Criterion (NC) rating of no more than 35.

Most lecture halls require a sound reinforcement system, both for voice amplification and playback of various audio sources. The placement of audio speakers is important in making certain that all areas receive a strong, clear signal.

The mix of sound-reflectant and sound-absorbent materials must be carefully calculated to control reverberation without creating a sound-deadened room. The appropriate blend of the two sounds (source and reflected) is achieved by controlling reverberation time. There should be no more than about 30 milliseconds difference between the arrival of source sound and reflected sound. As the interval approaches 70 milliseconds, the listener may perceive a separate sound or echo.

Walls

For acoustical value, walls in the lecture hall should be non-parallel, and should have a rough or textured surface. Side walls should be angled away from the instructor area in a fan-shaped pattern to focus sound toward the audience and the back of the room. The rear wall surface should not be parallel to the front wall and should be tilted, textured, or faceted to prevent "slap-back" noise that bounces directly toward the instructor. All walls should have a Sound Transmission Coefficient (STC) rating of no less than 50, and should extend to the floor above or to the roof construction. Most rooms have suspended ceilings which hide mechanical systems, cabling, etc. so walls that stop at the ceiling may allow sound to travel from room to room as well as create security problems.

The front wall that contains the teaching station should utilize hard surface materials. Sound-dampening materials should be applied to the rear and side walls as needed. In many instances, the back wall may need to be 50-100% covered with acoustical absorption materials.

Ceiling

The ceiling is the most critical element in insuring that the sound in the lecture hall is distributed evenly and at appropriate loudness to all portions of the seating area. The ceiling should act as a sound mirror, reflecting sound downward to blend with the sound from the speaker system. To achieve this the ceiling should be sloped or stepped and the majority of the ceiling should be primarily of a hard surface. If the ceiling has too much sound absorbant material, the loudness will diminish at the back of the room.

If some acoustical treatment is needed as part of the ceiling, it should be installed around the sides and rear in a horse-shoe shape, with the front and middle sections of hard-surfaced, sound-reflectant materials. If needed, acoustical treatment normally will not exceed 40-50 percent of the total ceiling surface.

To enhance the instructor's voice projection, the ceiling should be hard surfaced nearest the instructor, and tilted at an angle from the ceiling to the front wall, similar to the ceiling of an orchestra shell.

Seats in some lecture hall may not be able to receive sounds that are reflected from the ceiling, which is often the case for seats beneath a balcony. In these situations, the sound reinforcement system should include speakers with appropriate sound delay to eliminate the echo effect often experienced in these seats.

Floor

The amount of tile and/or carpet used will have an impact on the acoustics of the room and should be given careful consideration during the design phase of the project.

LIGHTING SYSTEMS

Lighting in large lecture halls is a particularly critical element, not only because of the increase in the use of technology in teaching, but also because of the lack of natural light typically available in these facilities. Correct lighting levels can be achieved through a variety of approaches. It is essential that the lecture hall have a full range of capabilities, from a comfortable reading level of light to a minimum level of light needed for note taking during projection. Further, it is essential that lighting controls be designed for ease-of-use since the instructor's first concern is the communication of content not the operation of equipment.

General Room Lighting

The lighting in the student and instructor areas should be on separate zones. It should be possible to switch zones of ceiling lighting from the front to the rear of the room so as to maintain higher light levels in the rear of the lecture hall while reducing the light level in the front when using various projection devices at the front of the room.

Controls

Controls for the house lights in lecture halls are needed at every entrance into the room, including the at-grade entrance at the front of the room.

In addition to the house-light controls, a complete set of controls should be available at the instructor area and a second complete set of controls in the projection booth, if one exists.

If the lighting controls are preset controls, then a manual override should be readily available. In addition, both the preset and the manual override should be clearly labeled and simple to use.

Note-Taking/Dimmable Lighting

While zoning addresses one type of lighting control, dimming also will be needed. For certain types of projection, it should be possible to reduce the lighting level to 0-20 footcandles over the student stations, with no lighting over the aisles or spilling onto the walls, the instructor area, or projection screen.

Generally, incandescent lighting is preferred in lecture halls since it can be easily dimmed and controlled. If fluorescent lights are used, they should be selected carefully to make certain they can be controlled adequately. (See Chapter 2.) Often a combination of incandescent and fluorescent lighting is used in lecture halls, with fluorescents for general lighting that can be turned off during projection and with dimmable incandescents that provide different levels of lighting for different types of projection.

The design of the ceiling lighting should recognize the need to regularly change lamps. Lamp-changing is often difficult in a facility which may be heavily used and which may require special equipment to reach the high ceilings.

A work light must be provided in the instructor area but care should be taken to insure that the light does not spill onto the projection screen. A provision also must be made for lighting a sign language interpreter for hearing-impaired students (see APPENDIX A).

Emergency and Aisle Lighting

Emergency lighting and exit signs should conform to local codes and be self-illuminating. These should be located so they do not interfere with the image on the projection screens or provide visual distraction to the audience. Today, lighting is available in a small thin tube that will highlight aisle access. Aisle lighting also can be incorporated as part of the fixed seating.

ELECTRICAL AND TELECOMMUNICATION SERVICES

Electrical

It is essential that all lecture halls be provided with ample electrical power to meet all present-day needs as well as have additional power available for future applications.

No outlets anywhere in the lecture hall should be controlled by a switch that could be confused for a light switch.

Each lecture hall should have a minimum of two dedicated circuits with separate breakers controlling the service exclusively to the lecture hall. One of these should feed the front portion of the room and the second for the projection booth or equipment closet area, and neither should be shared by any other function within the building.

The breaker panel should be located near the lecture hall, and the breakers within the panel should be clearly labeled as to function.

The front of the lecture hall should be equipped with a minimum of four duplex outlets distributed evenly across the instructor area. In addition, two duplex outlets should be located in each of the other walls. At least two fourplex outlets should be located in the projection booth or equipment closet. If a ceiling mounted video projector is to be used, electrical service is needed in the ceiling.

Telecommunications

Voice, video, and data services should be provided from a telecommunications closet to the lecture hall. All of these services should terminate in the front of the room, the projection booth, and equipment closet.

A wiring box should be installed in the ceiling outside the lecture hall (convenient to the lobby or other entrance path into the room). This will provide maximum flexibility for making changes or additions to the service within the lecture hall.

Electrical and telecommunication services should be provided in the ceiling of the room to facilitate the installation of a video projector. To accommodate current technology, that termination box should be at a distance from the principal projection screen one and one-half times the width of the projection screen. Even as the technology changes, that location should be adequate for most applications.

Although the specific location of conduits or cable trays will vary depending on the design of the lecture hall, in general, connections are needed: 1) from the instructor area to the projection booth and equipment closet, 2) from the instructor area, projection booth, and equipment closet to the video projector (if it is ceiling mounted), and 3) from the front wall of the instructor area to the podium. Any new conduit or cable tray that is installed should contain pull wires. If the instructor podium is movable, then connections should be provided at the right, left, and center of the instructor area.

Some provision for telecommunications and electrical outlets in the student seating area may be desirable to accommodate the use of portable computers, recording devices, response systems, etc.

For distance learning capabilities, consideration must be given to camera placements, monitor locations, microphones for student-instructor interaction, etc. Also, lighting may need to be enhanced for quality television imaging.

See Chapter 2, Electrical and Telecommunications Services, for additional information.

CHAPTER 5
SEMINAR ROOMS

INTRODUCTION

As classrooms that accommodate up to 20 students, seminar rooms are designed to facilitate interaction and face-to-face discussion among students and instructor. These rooms sometimes are used also as for departmental meetings or conferences, but their primary purpose is for small class instruction.

Design guidelines for specific considerations such as doorway entrances, hallways, acoustics, finishes, and air ventilation and circulation, etc. are similar to the measures outlined in Chapter 3, General Purpose Classrooms. Refer to this section for advice and recommendations regarding these issues.

DIMENSIONS

The room dimensions, the length to width ratio, for seminar rooms should be 1:1 or 1:1.5. Total room area should allow 20 square feet per student station. Long narrow rooms with dimension ratios greater than 1:1.5 limit eye contact and reduce personal interaction among participants in a class. Ceiling height should be ten feet minimum.

The projection screen or chalkboard/markerboard defines the front of the room. If achieving maximum capacity is an objective, a single entrance at the front of the room will allow the incorporation of the entry space into the instructor area. A single rear entrance reduces interruptions from late-arriving students but will require more space.

Although a formal teaching or presentation area is usually not as elaborate in a seminar room, the front of the room should be large enough to accommodate a lectern and provide enough space to use an overhead projector. It is strongly recommended that any overhead projector used in a seminar room be equipped with a short focal length lens to reduce the distance from the projector to the screen. Placing the overhead projector on the table where students sit is not recommended because it usually blocks the view of the screen. Sufficient space is needed at the front of the room for the projector to be on a cart that puts the top of the projector stage on approximately the same level as the table surface.

WINDOW AND WALL TREATMENTS

Fenestration should be kept to a minimum. All windows must be equipped with window coverings (shades, drapes, venetian blinds) that are opaque and mounted to prevent ambient light leakage around the edges. For more details on windows, refer to the section on window treatments in Chapter 1.

To protect the wall surfaces, wainscot chair railing is often installed in seminar rooms to prevent the backs of charis from rubbing and scarring the walls.

FURNISHINGS AND EQUIPMENT

Movable tables and chairs are the primary furnishings for seminar rooms. Tables should be rectangular or trapezoidal, and table tops should have a durable hard plastic laminate or equivalent finish. A pvc edge is more durable than a self-edge. Tables may be anywhere from 18 to 30 inches deep and provide a minimum 30-inch wide work space for each student. Deeper tables will increase station size and reduce seating capacity. Bases should have adjustable glides for leveling.

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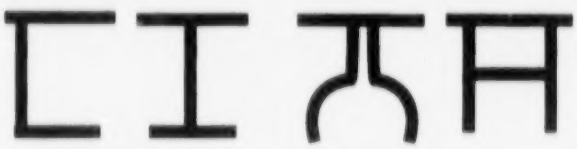
The type of table legs and their placement will affect how many students can sit comfortably at each table. T-shaped or L-shaped legs usually allow students to sit comfortably without bumping their knees on the legs. In addition, the closer the legs are to the end of the table, the more flexible and comfortable the seating.



More Flexible Less Flexible

Table Leg Styles
(end view)

More Flexible Less Flexible

Table Leg Placement
(side view)

Seating can range from standard armless, straight-back chairs to adjustable, upholstered arm chairs on casters. If chairs are on casters, they should have 5 legs. If arm chairs are used, the arms must fit under the table and the width of the arms must accommodate the 95th percentile male. On carpeted floors, chairs should have either wide wheels or sled runners for long wear and durability of the carpet. A portable lectern (floor or tabletop) should be placed in the room.

There should also be an electrical clock on one wall in each room. If battery-powered clocks are used, regular maintenance checks are required to replace the batteries.

MULTIPLE USE CONSIDERATIONS

Seminar rooms that also will be used as meeting or conference rooms should have built-in counter space, with lockable storage. If the room will be used on a regular basis for functions at which food will be served, consideration should be given to installing a sink with hot and cold water and providing space and electrical service for appliances, such as a refrigerator, microwave oven, and coffee maker. A minimum of one duplex electrical outlet should be provided above the counter. Any outlet located near a sink should be protected with a ground fault interruption circuit (GFIC). A coat rack or closet with a shelf that has a capacity equal to room occupancy is needed.

CHALKBOARD/MARKERBOARD

Seminar rooms typically require a large amount of chalkboard or markerboard space. The boards should be four feet high and mounted to the wall so the bottom edge is three feet above the finished floor. A two-inch tack strip with movable mounting/map hooks should be above the writing surface. One 3 x 4-foot tack board should be placed in the room.

PROJECTION SCREEN(S)

A minimum 70-inch by 70-inch matte white projection screen is generally mounted on the front wall of the room. The screen should be mounted 10-12 inches from the wall to correct the keystoning effect, and a tieback anchor at the bottom center of the screen and below the writing board tray should be provided. If users need to use the writing surface and the projection surface simultaneously then the projection screen should be placed to one side of the instructor's writing board or in the front corner of the room.

AUDIOVISUAL EQUIPMENT AND CONTROLS

Often, portable audiovisual equipment is used in seminar rooms so that it can be shared among several locations. The use of technology in instruction has increased, however, to the point that institutions should consider permanently installing a video/data monitor (corner location, ceiling or wall mounted), an equipment rack, and/or a storage cabinet/projection station located in the rear of the room for a slide projector and other equipment.

Today, most electronic equipment can be operated with a remote control, which eliminates the need of the intructor to be physically near the equipment to control its operation. For some items, 16mm projectors for example, it may be easier to operate them at the device. Still others such as slide projectors, may require conduit running from front to rear to provide control cables to the teaching area.

LIGHTING SYSTEMS

A minimum of 50-60 foot candles should be provided at the writing surface of student stations. Lighting fixtures should be in banks which run from the front to the back of the room. Light switches should control illumination from 1/3 to 2/3 to full intensity, and the row of lights nearest the projection screen should be switched off during projection use. For most seminar rooms, fluorescent lighting alone will be sufficient. If incandescent lights are used, either independently or in addition to fluorescent, they should be dimmable to a level of 5-10 foot candles over work surfaces.

Fixtures should be flush-mounted in the ceiling to avoid interfering with visual image projection. Light fixtures should not be mounted near the projection screen where they could interfere with the projected image. Light controls must have standardized switch patterns and be located at entry door, with at least one switch convenient to the teaching area.

ELECTRICAL AND TELECOMMUNICATIONS SERVICES

Each room should have one or more dedicated circuits on a breaker not shared by any other room, and at least one grounded 120 volt duplex outlet centered on each wall, mounted 18 - 24" above the finished floor.

Connections to voice, video, and data services should be provided in the front of each seminar room for use with portable computers and other electronic technology by students and faculty.

CHAPTER 6
SPECIALIZED CLASSROOMS

INTRODUCTION

As more technology is integrated into teaching and learning activities, a need for special adaptations to the general classroom and lecture hall has arisen. This chapter discusses the general design characteristics and features that should be considered when planning the two most common types of specialized learning spaces--distance learning or interactive video classrooms and computer labs/classrooms. The intent of this discussion is to give some basic guidance for designing these facilities with the realization that each institution must adapt them to fit their situation.

DISTANCE EDUCATION OR INTERACTIVE VIDEO CLASSROOMS

Classrooms which are to be used for delivering instruction to distance learners must first be carefully designed general classrooms. Distance education or interactive video classrooms generally display the following characteristics:

- They seat from six to thirty students at an origination site and one or more remote sites.
- They are connected electronically to one or more video, audio, and/or computer telecommunications networks.
- They require additional technical support and training for proper utilization by learners and instructors.
- They allow users to incorporate interactive and other instructional approaches to enhance distance learning activities.

Although distance learning facilities should follow many of the recommendations of the previous chapters for technology usage and space layout, they require additional planning and analysis during their development and construction. All these specialized facilities should start with a careful assessment of their specific goals and objectives, the functions to be provided, and the exact activities to be engaged in by the learners and the instructor.

The following characteristics and features are ones that have been found to be critical in the design of good distance education classrooms.

Telecommunications

The selection and type of distribution systems to be used within and without the distance education classrooms is key to the scope and complexity of the design. Planners should determine the specific technologies (compressed, full-motion video, switch 56 teleconferencing, etc.) that are to be utilized by the distance delivery network as early as possible in the design process. Each of these technologies have specific requirements and limitations that must be accommodated in the facility design (for both the origination and remote classrooms).

Size of Classroom

More space is generally needed in distance learning facilities. From 30-40% additional square footage may be needed to accommodate additional equipment and provide adequate work space for the instructor and students. In addition, extra space may be needed to provide adequate camera angles.

Student Seating and Work Space

A minimum of 24" x 30" should be available for each student at tables. If equipment such as monitors or microphones are installed at student stations then 30" x 36" may be needed. High quality movable chairs on castors should be considered for learning activity flexibility.

Space for peripherals (such as FAX machines and recording equipment) should be provided. Extra storage and work counters may also be needed in these classrooms.

Teaching Console and Station

Due to the need for complex technology sources and equipment, the teaching station/console requires special planning and design. Document cameras, computers, viewing monitors, etc., must be easily operated and serviced. A wing-shaped or L-shaped teaching console should be considered. The height of the teaching station should accommodate the presenter both in a seated and standing mode. An adjustable instructor stool/chair will provide this flexibility.

Windows

Distance learning rooms should not have windows. The mixture of natural and artificial light in a room with windows creates problems since most cameras balance for one type of light or the other. Mixing the two types of light will mean that colors will not appear true.

Lighting

To provide sufficient light for the cameras, lighting levels should be increased 50-100% over that recommended for general purpose classrooms. Generally, 80-90 footcandles is the minimum needed in the seating area while 100-130 footcandles is preferable for the presentation area. This means that additional lighting (studio broads) may be needed for presentation area and should be properly placed to improve facial highlights.

Walls

Neutral blues and grays should be used for wall and camera background surfaces in order to improve the video separation of flesh tones in television images. The design should provide a clean visual surface behind the presentation console. The drape or wall area should provide an appealing non-glare backdrop with adequate image contrasts. Whiteboards may present problems because they create excessive contrast and glare.

Ceiling

The ceiling may need to be higher than a normal classroom to provide sufficient height for lighting instruments, microphones, etc. In addition, higher ceilings will allow cameras to frame shots so that ceiling lights will not be visible, which creates too much contrast for most cameras to get a good image.

Acoustics and Sound Treatment

Sound quality is key to effective communication among distance learning sites and classrooms. Extra acoustical treatment, such as drapes and wall coverings, should be included in these spaces to improve sound quality. It is recommended that reverberation testing and sound engineering be part of the design process of any distance learning facilities. The audio system designer should consider the usage of voice activated microphones for students and wireless microphones for instructors. High quality audio components, preferably ones specifically designed for use in distance learning applications, should be utilized.

Viewing

Special attention must be taken in the placement, size, and quality of viewing monitors in distance learning classrooms. The degree of eye and head movement by learners should be minimal when moving between monitors and 'live' presenters. The mounting height for screens or monitors must be limited and must provide equal viewing from all seats. This will probably require more and larger display screens than recommended for general classrooms. In some distance learning spaces, small individual monitors for every one or two learners are installed on or within learner work tables.

Front video projection systems are not recommended for distance learning rooms since they create lighting problems for the camera and the images they project are not as bright and clear as with direct view monitors, or even rear screen monitors.

Technology

The technical requirements of distance education classrooms can be accommodated in two general methods. The hardware can be built into the teaching console and other cabinet areas in the room itself or the technology can be placed in an adjacent control room area. The decision on which method to be utilized should be based on the degree of technical support or staffing generally provided to the users of the classroom. The more technical support staffing that is planned, the greater is the need for separate support/control rooms. If the facility is designed to be operated by the instructor, then special attention must be given to the placement of all controls and their ease of use.

The location and mounting height of cameras and student monitors should provide natural viewing images and eye contact with the other classrooms in the system. 'Birds-eye-views' or high angles should be avoided. The need for special functions such as video production recording activities, computer image development and presenter work/prep areas should be considered when designing distance education classrooms.

Heating, Ventilation, and Air Conditioning

Because of the technology, distance learning rooms may require special heating, ventilation, and air conditioning systems. Year-round air conditioning is recommended to handle the heat and humidity. In all cases, but especially if microphones are to be hung from the ceiling, careful attention should be paid to the placement of air ducts and the velocity of air coming from the ducts.

COMPUTER LABS/CLASSROOMS

Making computers available for students to use is increasingly important. Although many institutions are encouraging, or even requiring, students to purchase their own computers, there is still a need to provide computer labs or classrooms to support instruction. These computer facilities serve important functions. First, they provide computers that students can use on campus. Few students have portable computers and often do not have enough time between classes to return to their dorm or off-campus housing to use a computer. Second, computer labs and classrooms often have specialized software or peripherals that students may need for class assignments and would be too expensive or require too sophisticated a computer for students to purchase on their own.

For purposes of this discussion, computer lab refers facilities where students come to work individually. Computer classroom refers to facilities where an instructor can bring a class of students and have access to presentation capability for group instruction. Labs and

classrooms share some characteristics and capabilities but there are important differences that should be recognized by facilities planners. It is possible to design a facility to serve both purposes (open to individual students between classes), but when this occurs, the requirements for a computer classroom should take precedence over those for a lab.

Telecommunications

Computer labs and classrooms share a need for good telecommunications capability. To provide access to a wide range of resources, each computer should be networked, preferrably to a local area network (for file sharing, printing, shared applications, etc.), a campus or wide area network, and to the Internet.

Electrical

Electrical service that provides protection from surges and spikes is crucial. The number of circuits should be determined based on the equipment to be housed in the room with some room for future expansion. An uninterruptable power supply (ups) will be needed for the server and other critical equipment, and if resources allow, for all the computers.

Wiring/Cable Management

The wiring for all electrical and telecommunications services should be carefully planned so that outlets are placed appropriately for the arrangement of the room. All cables should be neatly dressed and covered in moldings or other cable management devices. All cables and outlets should be clearly labelled. Minimizing cable clutter is not only important from an aesthetic perspective, but can reduce unintentional cable disconnections, improper connections, etc. Please note that the arrangement of the seating has a bearing on the accessibility of the cabling (see configurations below). A raised floor allows for more flexibility and keeps cabling out of the way but is expensive.

Seating and Work Space

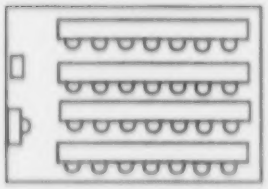
Since students often sit for long periods at the computer, especially in computer labs, it is critical that the seating and furnishings are comfortable. For this reason, padded chairs with casters are preferred.

Each work space must allow sufficient room for the computer and any peripherals, as well as for student notebooks and papers. A minimum of 36" wide may be sufficient for one person, although 48" is preferred. If two students may share a computer, then 48-60" is necessary. The height of the work surface should allow the keyboard to be at a comfortable height for typing (29-31"). The type of furniture can range from computer tables to carrels and must be selected based on the type of activity that will go on in the room.

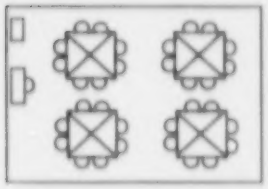
In a computer lab, providing separation among the work areas is more important than in a classroom, where interaction among the students is wanted. For this reason, labs often use carrels with high sides. This not only reduces visual distractions but can reduce noise levels if the sides are covered with a sound absorbing material. In a classroom, carrels with high sides are not appropriate because they block the view of the instructor area and limit student interaction.

Since viewing angles and instructor areas are not critical in a computer lab, the individual work spaces can be arranged in a more compact configuration. For a computer classroom, several options are possible and each offers a variety of advantages and disadvantages.

COMPUTER LAB CONFIGURATIONS

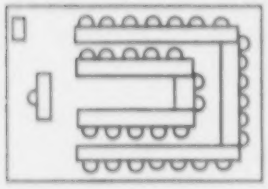


ROWS
Provides a very compact arrangement and has a low station factor compared to other options.

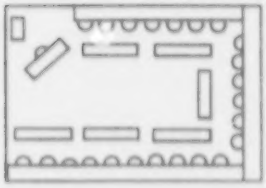


CLUSTERS
Not as compact as rows but provides a more varied and aesthetically pleasing arrangement. Good work spaces that are designed to seat two or more students.

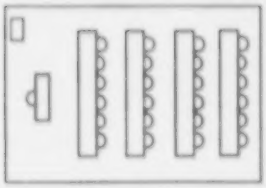
COMPUTER CLASSROOM CONFIGURATIONS



U-SHAPED (IN)
Allows students to see each other but sight lines to center projection screen are not good for students in the outside front seats. Can be tiered to improve sight lines in rear rows. Requires more space since the middle is not very usable. Hard for instructor to move among students as they work.



U-SHAPED (OUT)
Students face the wall when using computers and turn inward to face instructor during presentations (computer tables may have L-shaped extension or the room may have movable tables in center). Easy for the instructor to see all student screens and move among them. Easy for students to break into groups or move around. Requires lots of space. Keeps all cables and connectors out of the way.



AISLE
Two side aisles are preferred over one center aisle (which wastes the best viewing area). May need to be tiered to improve sight lines.

The capacity of the room depends on many factors--the size of the furniture, how it is arranged, the amount of other equipment in the room (servers, printers, projectors), storage, etc., For this reason, station factors can range from 20-25 up to 35-40 sq. ft. per person. In some cases, a separate support space is used to house servers, provide storage, etc.

Support Space

A separate support space to house servers, support staff, supplies, etc. is desirable. The best arrangement is for the support space to be adjacent to the main room with a connecting door as well as a door leading directly into the hallway. It is even possible to put the computer CPU's here to reduce noise and heat buildup in the student space. This also makes it easy to replace malfunctioning equipment. The initial cost to put CPU's in the support space is somewhat higher since it involves more cabling and a more complicated installation but it makes maintenance easier and less time consuming. If CPU's are located in the support space, sufficient electrical communication outlets are needed.

Teaching Station

The teaching station in a computer classroom should be carefully designed so it is easy to operate and provides access to all necessary teaching tools. This usually includes an instructor computer and controls for the data projection system, lighting, and any av equipment installed in the room. Additional capabilities may include a document camera, a system for displaying the screens of student computers, and a video recording system for taping classes or connecting to distance learning systems. A video system can also allow the staff in the support space to monitor the class and deal with problems without entering the classroom.

Ceiling Height

The ceiling height in a computer lab is not as critical as in a computer classroom, where seeing the instructor and screen are important. Also, since computer classrooms sometimes have tiered seating, additional height is needed to avoid a closed-in feeling in the back tiers.

Lighting

In a computer lab, good overall lighting that does not create glare on screens is needed. In a computer classroom, use the same general principles as with other classrooms (see Chapters 2 and 3) but with the additional need to prevent glare on computer screens. If a video recording system is planned for a computer classroom, higher light levels are needed for the cameras (see previous section on Distance Learning Classrooms).

Heating, Ventilation, and Air Conditioning

Given the concentration of equipment found in computer labs and classrooms, HVAC systems should be sized and balanced to handle the anticipated load. Also, year-round air conditioning is necessary to handle the heat and humidity. When computers are located in the classroom, rather than a support room, they general additional heat and noise. Careful attention should be paid to the placement of air ducts and the velocity of air coming from the ducts so that additional cooling is delivered but without increased air noise.

Acoustics and Sound Treatment

Because computers generate noise (from fans and keyboards), rooms full of computers can be loud. In a computer lab, a very "dead" space is desirable. This means that sound absorbing material can be used throughout (ceiling tiles, wall coverings, floor coverings, carrel walls).

In a classroom, however, you need normal room acoustics so that the instructor and students can communicate easily. (See Chapters 2 and 3.) As mentioned earlier, installing the CPU's in an adjacent space can reduce noise. It may be advisable to install a sound reinforcement system if noise is a problem.

Accessibility

A few stations should be adjustable in height or provide 31" clearance to accommodate users in wheel chairs. In addition, printers, scanners, and other devices should be low enough for people in wheel chairs to operate them. Alternative input and output devices as well as specialized software should be available.

CHAPTER 7

CLASSROOM MANAGEMENT PRACTICES AND POLICIES

INTRODUCTION

Many colleges and universities are faced with instructional spaces that are inadequate in quantity, quality, size, technology, and location. For this reason, every institution should have a classroom development plan. The first step toward a sound development plan is an accurate inventory of existing classroom facilities.

Once complete, the inventory can serve as a basis of comparison to measure actual instructional needs against specific classroom requests stated by the academic units. Deficiencies can be documented, summarized and distributed throughout university departments who are responsible for classroom scheduling, design, maintenance, renovation, and technology. In addition, the analysis provides campus planners and architects with valuable information on what types of instructional space should be included in future construction on campus.

ASSESSMENT OF EXISTING CLASSROOMS

A detailed inventory of all instructional spaces needs to be done. In most cases, this involves conducting a room-by-room inventory of general classrooms, not specialized teaching laboratories.

Classroom Inventory Components

- Inventory of Instructional Spaces (Classrooms)
- Building Name and Number (if applicable)
- Room Number
- Size of Room in Square Feet
- Location or Zone on Campus
- Room Capacity
- Room Attributes:
  - Floor (Flat, Sloped, or Tiered)
  - Linear Feet of Chalkboard
  - Windows (Number)
  - Window Darkening Capability (Type)
  - Projection Screen(s) (Number & Size)
  - Computer Equipment
  - AV Equipment
  - Audio/Video Connections
  - Data Connections (Type, Number, & Location)
  - Telecommunications (Voice)
  - Lighting (Zoned, Dimmable, Incandescent vs. Fluorescent)
  - Electrical Outlets (Number & Location)
  - Tackboards
  - Maphooks
  - Projection Booths/Equipment Closets
  - Handicap Accessibility
  - Air Conditioning
  - Seating (Number & Type)

Once the inventory of rooms is completed, the next step is to assess the condition of the rooms. Room condition audits should be conducted annually. Items which require special attention are included below.

Room Condition Assessment

- Lighting of Room
- Window Coverings, if applicable
- Sound Controls
  - In-Room Sound Amplification
  - Acoustical Surfaces
  - External Noise
- Thermal Conditions
  - Temperature Control
    - Air Conditioning
    - Heat Source
  - Air Flow
- Teaching Surfaces
  - Chalkboard Linear Footage
  - Markerboards Linear Footage
  - Tackboard
  - Map/Chart Rail Above Chalkboard
  - Demonstration Bench/Table/Desk
    - Services: Power, Natural Gas, Compressed Air, Vacuum, Water, Sink
  - Projection Screen(s)
- Equipment
  - Slide Projector
  - Overhead Projector
  - Film Projector
  - Video Camera
  - VCR
  - CD Player
  - Video Disc Player
  - LCD Panel
  - Easel or Chart Stand
  - A/V Cart
  - Teaching Equipment Storage
  - Lectern With Controls
- Fixed Equipment
  - Student Coat Hooks or Book Racks
  - Sink with hot and cold Water
  - Projection Booth
  - Window Shading Type: Drapes, translucent rollers, opaque rollers, venetian blinds, black-out shades, other
  - Projection Screen(s)-Number, Size, Condition, Location
  - Teaching Material Storage
- Furniture
  - Student Seats
    - Type
    - Arrangement
  - Student Tables
    - Type

- Teaching Station
  - Lectern
  - Desk
  - Chair
- Waste Receptacle

Room Surfaces
- Floor Material
- Ceiling Material
- Teaching Wall Material

Services
- Power 120 V
  - 220 V
  - Multi-phase
- Data Outlets
- Voice Outlets
- Video Outlets

Access and Circulation
- Access to Room
- Aisles Free Width
- Location (1st floor, etc.)
- Elevator Access
- Front to Back Aisle Clearance

Space Allocation
- Space Per Student
- Teaching Station
- In-Room Circulation

Room inspections conducted by designated campus representatives from such departments as the registrar's office, physical plant maintenance, facility planning and management, instructional technology support services, audiovisual services, and telecommunication services will raise the level of interest in classroom quality. During these inspections, the quality assessment can be accomplished.

In addition to the Classroom Condition Assessment, there are other ways to keep abreast of classroom deficiencies on an ongoing basis.

- Examine classroom hotline telephone records to determine which rooms have chronic problems, the types of problems that recur, and the extent of work required to correct them.
- Confer with classroom technicians who respond to trouble calls from faculty to identify specific problems and obtain suggestions for solutions.
- Since room inspections usual occur when rooms are empty, surveying students and faculty who use the classrooms can identify problems of importance to users.
- Use classroom committees to facilitate cooperation and communication among those who manage, maintain, design, and use classrooms. Faculty representation is necessary to provide a user perspective and should include users of all sizes and types of classrooms.

COMPARING INVENTORY WITH DEMAND

A comparison of the existing classroom inventory with the course demand generated by academic departments produces the composite classroom analysis. Assessments should be based upon enrollment data from the academic term with the highest enrollment, usually Fall term. Rooms should be categorized by seating capacity, similar to the chart below. Once rooms are categorized, room demand can be compared to supply. The table below offers an example.

Classroom Seating Capacity	No. of Rooms Available with Capacity (Supply)	No. of Rooms Needed with Capacity (Demand)	Current Need*
<20	10	5	-5
21-30	30	27	-3
31-40	30	32	2
41-50	40	47	7
52-75	18	24	6
76-100	10	12	2
101-120	5	9	4
121-150	5	2	-3
151-200	5	4	-1
201-250	4	3	-1
251-400	3	4	1
401-800	1	2	1
TOTAL	161	171	10

* Current need is based upon classrooms being scheduled 75% of the 45 hour week; and when scheduled have a 67% fill ratio for seats.

At large campuses, it may be desirable to separate classroom supply into zones across campus to reflect specific needs of academic units. For example, if all foreign language departments generate a need for 40 classrooms in the size ranges of 20-50, but no rooms of that size are in their area of campus, there is a mismatch on locational need.

One way to increase the supply of classroom hours is to start the day on the half hour at 7:30 am and to extend the ending time to 5:30 pm. This provides a 50-hour daytime class week instead of the typical 45 hour week (based upon 8 am to 5 pm Monday through Friday). Further, the evening time schedule should permit students to attend more than one class per night when necessary.

CLASSROOM UTILIZATION

Just like the utilization of any resource, institutions of higher education need to understand how their classroom resources are used. Facilities planners are asking questions like:

- How do classroom capacities compare to course section sizes?
- How do their equipment and furnishings compare to what departments need?
- How well are the classrooms used?
- What sizes should additional classrooms be?
- What are the weekly student contact hours?
- What is the student station fill ratio?

If these questions sound familiar, it is because appropriate utilization of limited resources should be a concern at every institution, regardless of its size, history, location or mission. Facilities managers face constant pressure to balance the dynamics of space needs. Often, it is difficult to differentiate between user needs and user wants or to determine how much weight can and should be given to factors such as convenience of location. At the same

time, facilities managers must respond to a host of other needs, such as energy savings, renovations, office/classroom conversions, surge space, accessibility, and asbestos removal. If classroom utilization information is not readily available, institutions face the possibility of classrooms being "reallocated" to other space needs, from faculty research space to computer labs, without adequate consideration for classroom needs.

One way to maximize the utilization of classrooms is to make certain that the existing facilities match the needs. For example, if the only classrooms that have video projection capabilities have a room capacity of 150 seats, and a course with a section size of 50 needs video data projection, the station utilization would be only 33%. Optimum utilization for general purpose classrooms is considered to be 75% room utilization and a seat fill ratio of 67% when the room is scheduled.

Several states have established statewide classroom utilization guidelines which influence the funding of new or renovated classrooms. Below are the standards for 13 states:

COMPARISON OF CLASSROOM STANDARDS/GUIDELINES
AMONG STATES HAVING THEM

STATE	UTILIZATION EXPECTED	SEAT FILL EXPECTED	SQUARE FOOTAGE PER STUDENT STATION EXPECTED
California*	76%	66%	15.0
Colorado	67%	67%	15.0
Florida**	78%	60%	22.0
Kansas	67%	60%	15.0
Maryland	73%	65%	16.3
Nebraska	67%	65%	16.0
New Hampshire	67%	60%	16.0
New Jersey	76%	70%	16.0
New York classrooms	67%	60%	16.0
New York lecture halls	44%	60%	12.0
Ohio	70%	67%	15.0
Oregon	73%	60%	15.0
Tennessee	67%	67%	15.0
Utah	76%	67%	16.0

* based on 14 hour day, Mon.-Fri. **Based on 15 hour day, Mon.-Fri.

Source: Report 90-93, California Postsecondary Education Commission, January 1990.

If utilization goes above these standards, scheduling flexibility is greatly reduced, particularly for matching room characteristics to faculty needs and for scheduling impromptu lectures and special help sessions.

CLASSROOM MANAGEMENT

General purpose classrooms, seminar rooms, and lecture halls are an institutional resource and can be managed and scheduled by one of three models.

- Central management and scheduling for all classrooms of all types, including labs.
- Dispersed management and scheduling at the college and/or department level for all classrooms of all types.
- A combination model in which some rooms and/or room types are handled centrally and others by college and/or departments.

Historically, classrooms managed and scheduled by a central scheduling office are better utilized than those scheduled by individual departments. It is vitally important that the university registrar or similar central department be charged with scheduling and management authority of classrooms.

A committee or group of interested parties (such as representatives from the registrar, audiovisual services, computing technology services, telecommunication services, physical plant, facility planning and faculty) can be a strong advocate to protect and improve classrooms. Such groups have been successful on several campuses, including Penn State and Ohio State. Not only can such groups help define who is responsible for what, but many have gone on to develop classroom design and utilization criteria which are distributed to those offices and individuals directly responsible for scheduling, maintaining, renovating, or constructing classrooms. It is also helpful to involve group members in the formal review process for renovation and construction projects to insure that guidelines are followed.

One critical factor to reaching the goal of optimizing scheduling and utilization is to establish and enforce a policy which requires academic units to distribute their course offerings throughout the available period of the day and the days of the week. The figure on the next page shows a sample of a distribution form that is completed by the academic department planners at one university which, if followed, will distribute the courses of the department and college equitably and reduce the demand for the historical peak period of 10 am to 2 pm.

SUMMARY

Effective classroom management entails all of the above practices, procedures and protocols. Today, classrooms are becoming expensive resources that must be managed efficiently. Institutions can obtain full use of this valuable resource by following these simple practices:

- Document problems with existing classrooms by means of a room inventory survey.
- Create a classroom data base in which to store classroom data.
- Adopt classroom management policies.
- Adopt design guidelines
- Budget annually for classroom equipment and furnishings maintenance and replacement.
- Form a classroom committee.
- Prepare Programs of Requirements for renovations or new construction projects.

COURSE OFFERING DISTRIBUTION SHEET
SPRING SEMESTER 19____

DEPARTMENT _____ CONTACT PERSON _____

TELEPHONE NO. _____ USER ID OF CONTACT PERSON _____

	MON	TUE		WED	THU		FRI	Row Total
1 8:00-8:50 13 8:00-9:15	1	1	13	1	1	13	1	1 + 13 [(F)]
2 9:05-9:55	2		14	2		14	2	2 ( )
3 10:10-11:00	3	3		3	3		3	3 + 14 ( )
4 11:15-12:05 15 11:15-12:30	4	4	15	4	4	15	4	4 + 15 ( )
5 12:20-1:10	5			5			5	5 ( )
6 1:25-2:15 16 1:00-2:15	6	6	16	6	6	16	6	6 + 16 ( )
7 2:30-3:20 17 2:30-3:45	7	7	17	7	7	17	7	7 + 17 ( )
8 3:35-4:25	8			8			8	8 ( )
9 4:40-5:30 18 4:15-5:30	9	9	18	9	9	18	9	9+ 18 [(G)]
COLUMN TOTAL	MON [(A)]	TUE [(B)]		WED [(C)]	THU [(D)]		FRI [(E)]	TOTAL [(**)]

1. MON+WED+FRI / TOTAL = [(A)] + [(C)] + [(E)] / (**) = ( ) % may not exceed 70%

2. TUE + THU / TOTAL = [(B)] + [(D)] / (**) = ( ) % may not exceed 45%

3. (1 + 13) + (9 + 18) / TOTAL = [(F)]+ [(G)] / (**) = ( ) % must exceed 20%

4. ANY ROW TOTAL MAY NOT EXCEED 15%

APPENDIX A
DESIGNING FOR ACCESSIBILITY

To be useful, thorough, and concise, excerpts are provided from various regulations and publications for barrier free teaching and learning facilities. However, this section should not serve as a substitute for the complete set of guidelines published in the *Americans With Disabilities Act of 1990 (ADA)*. Designers and planners working on classroom facilities should consult the ADA guidelines, applicable state codes and regulations, and other related materials for more detailed information.

AMERICANS WITH DISABILITIES ACT

The Americans with Disabilities Act (ADA), enacted July 26, 1990, prohibits discrimination against persons with physical and mental disabilities. This means that individuals with disabilities are extended civil rights similar to those now available on the basis of race, color, sex, national origin and religion through the Civil Rights Act of 1964.

The ADA is modeled after that Act and Section 504 of the Rehabilitation Act of 1973. Regarding standards for remodeling and new construction, Title II of the ADA states that, Apublic@ institutions can choose to follow either UFAS (Uniform Federal Accessibility Standards) or ADAAG (Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities) standards. State supported universities also must comply with their state's accessibility laws.

The term "disability" is defined as a physical or mental impairment that substantially limits one or more major life activities, such as walking, seeing, speaking, or hearing. A record of such an impairment, or of being regarded as having such an impairment, also qualifies under the ADA's definition of disability.

The special requirements of students and faculty with disabilities must be considered when designing and renovating classrooms. Any building constructed or altered after the effective date of the law must comply with the ADA. Rather than requiring a public institution to make each of its existing facilities accessible, the ADA requires that "each service, program, or activity conducted by a public entity, when viewed in its entirety, be readily accessible to and usable by individuals with disabilities." Program accessibility can be achieved by a number of means, such as redesigning equipment, reassigning services to accessible buildings, providing aides, altering existing facilities, constructing new facilities, and other means which provide services in an integrated setting.

In making programs accessible, public institutions need not take action that would threaten or destroy the historic significance of an historic property or that would fundamentally alter the nature of the service activity or program or would result in undue financial and administrative burdens. In these cases, the institution is required to take any other action to provide the required access.

Over 43 million U.S. citizens have physical or mental disabilities. Some persons with disabilities require the use of wheelchairs, crutches, or guide dogs. These visible conditions require special consideration in the physical design of classrooms, but other less visible conditions also must be addressed. For example, conditions such as hearing loss, limited vision, energy limiting conditions (such as cardiopulmonary disorders), and mental disabilities often are invisible but can impact mobility and academic performance. It also should be noted that disabilities can be temporary or permanent.

The goal of classroom designers is to keep in mind all potential users, including persons with mobility, hearing, vision, and mental disabilities. In this context, the following information regarding the concept of "universal design" for barrier-free facilities is provided.

MOBILITY IMPAIRMENTS

Persons with mobility impairments often have conditions that limit their daily physical activities, such as walking, lifting, reaching, carrying, standing, and sitting. These impairments can range from carpal tunnel syndrome to quadriplegia, from asthma to cardiopulmonary disorders, and many can be energy limiting. In order for persons with mobility impairments to use classrooms and lecture halls, the facilities must be barrier-free. Standards which have been established for reach and rise limits for all persons, including those with differing abilities, can be found in *HUMANSCALE 1/2/3, Section 4 of UFAS, and Section 4.2 of the ADAAG.*

The ADAAG and UFAS differ in the scope of required wheelchair locations in areas of assembly. The guidelines for wheelchair locations vary with regard to room seating capacity from 1% to 6%. For new construction refer to Section 4.1.2 of UFAS or Section 4.1.3 of the ADAAG. For alterations, accessible seating areas may be clustered if technically infeasible to disperse throughout the altered assembly area. "Technically infeasible" is defined for building alterations as unlikely of being accomplished because "existing structural conditions would require removing or altering a load-bearing member which is an essential part of the structural frame; or because other existing physical or site constraints prohibit modification or addition of elements, spaces, or features which are in full and strict compliance with the minimum requirements for new construction and which are necessary to provide accessibility." (Section 4.1.6 of ADAAG)

If seating at fixed tables is provided for persons in wheelchairs, clear floor space and knee clearance should conform to Section 4.32 of ADAAG.

In larger rooms, such as lecture halls, where sloped or tiered floors are required in order to provide acceptable sight lines, accessible viewing positions shall adjoin an accessible route that also serves emergency egress.

Ramps must not exceed one foot rise in twelve feet of run (1:12 ratio), with a maximum rise of 30" and maximum run of 30' for any slope before level landings are required. Level landings (60" in length) must be provided at the top and bottom of each slope, and wherever the ramp changes directions. Handrails should be provided if a ramp run exceeds 72" or the rise is greater than 6". Section 4.0 of UFAS specifically highlights the regulations related to "Accessible Elements and Spaces: Scope and Technical Requirements." Ramps are specified in section 4.8 of the ADAAG.

The teaching station, including the chalkboards, audiovisual controls and projection screens, should be located and designed to be barrier free.

HEARING IMPAIRMENTS

Over 16,000,000 persons in the United States are hearing-impaired. The traditional approach to improving speech intelligibility during a lecture has been through the use of 'public address systems' terminating in loudspeakers on the walls or ceiling. There are two major limitations to relying solely on these systems. First, while increasing the intensity of the signal is possible with PA systems, such increases in volume often cause distortions due to the combination of the equipment characteristics and the stage and hall acoustics. Second, even

within the same lecture hall, the listening conditions can vary considerably in different locations, depending on the various ratios of direct to reverberant sound, changes of wave shape, fluctuations in decay characteristics and variations in sound levels.

A solution to improved sound transmission, particularly for persons with hearing loss, lies in the use of assisted listening devices. The purpose of these devices is to provide functional and effective listening and speaking environments so that people with hearing loss can increase their overall participation in general classrooms and lecture halls. Assisted listening devices supplement the existing loudspeaker system by providing a direct electronic coupling from the sound source to an appropriate amplification device where the signal is then transmitted to good quality, volume-controlled transducers which are located at or very close to the listener's ear canals. Most important to remember is that assisted listening systems provide improved speech clarity, not just volume control.

In cases where interpreters are utilized for deaf persons, consideration should be given to ensuring the visibility of the person signing, especially during reduced lighting presentations.

For new construction, if classrooms or lecture halls accommodate at least 50 persons, or, if they have audio-amplification systems, and they have fixed seating, they must have permanently installed an assistive listening system. In other existing locations, assisted listening systems may be portable or permanently installed. Section 4.1.3.b.(19) of UFAS and Sections 4.1.3(19), 4.33 and A4.33 of ADAAG describes minimum audio-amplification requirements.

Because of the complexity of issues involved, the design and use of classroom amplification systems should include audiologists, electrical engineers, acoustical engineers, audiovisual specialists, and maintenance technicians.

Given the increased amount of pre-recorded and broadcast video programming that is becoming available in closed captioned format, it is suggested that video display devices for use in classrooms be equipped with closed caption decoders.

VISUAL IMPAIRMENTS

Persons with visual impairments frequently have difficulty in classrooms and lecture halls. Instructors often reduce light levels in the seating area and/or the instructor area when projected images or display materials are used. Difficulties also result when light infiltrates projected images, such as sunlight flooding a screen. In addition, energy conservation efforts in recent years have resulted in a general decrease in illumination levels in public buildings, including schools. A further challenge for persons with low vision is the use of low-contrasting colors, such as using yellow chalk on a green chalkboard.

In order to eliminate barriers for persons with low vision, use as much contrast as possible in image selection. Light levels should not be extremely high or extremely low, since both circumstances can impair vision.

All of these considerations will assist planners in providing barrier-free, universal design for classrooms, seminar rooms and lecture halls.

APPENDIX B

REGULATIONS, CODES, AND COMPLIANCE AGENCIES

1. Regulations and Codes

American National Standard for Office Furnishings - General Purpose Office Chairs-Tests (ANSI/BIFMA X5.1-1985). Sponsored by the Business and Institutional Furniture Manufacturer's Association; New York: American National Standards Institute, Inc., July 1985.

American National Standard for Safety to Life from Fire in Buildings and Structures (ANSI/NFPA 101). Quincy, Massachusetts: National Fire Protection Association, Feb. 7, 1985.

American National Standard for Buildings and Facilities - Providing Accessibility and Usability for Physically Handicapped People (ANSI A117.1-1986). New York: American National Standards Institute, Inc., 1986.

Americans with Disabilities Act of 1990, Public Law 101-336 [S. 933], 42 U.S.C.A 12101 ET.SEQ. (Rules under 28 CFR Parts 35 and 36), July 26, 1990.

Architectural and Transportation Barriers Compliance Board, Americans with Disabilities Act (ADA) *Accessibility Guidelines for Buildings and Facilities*; Final *Guidelines* (36 CFR Part 1191). Federal Register, Part II, Rules and Regulations, Friday July 26,1991, 56(144), pp. 35408-35453.

The BOCA National Building Code / 1987 (10th ed.). Country Club Hills, Ill: Building Officials & Code Administrators International, Inc., 1986.

Department of Justice, Office of Attorney General, *Nondiscrimination on the Basis of Disability in State and Local Government Services; FINAL RULE* (28 CFR Part 36). Federal Register, Part IV, Rules and Regulations, Friday July 26, 1991, 56(144), pp. 35694-35723.

Department of Justice, Office of Attorney General, *Nondiscrimination on the Basis of Disability by Public Accommodations and in Commercial Facilities*; Final rule (28 CFR Part 36). Federal Register, Part III, Rules and Regulations, Friday July 26, 1991, 56(144), pp. 35544-35691.

Hopf, P.S., & Raeber, J.A. *Access for the Handicapped: The Barrier-free Regulations for Design and Construction in All 50 States.* New York: Van Nostrand Reinhold Company, 1984.

Lathrop, J. K.(Ed.) *Life Safety Code Handbook* (2nd ed.). Quincy, Massachusetts: National Fire Protection Association, Inc., 1981

Packard, R. T. (Ed). *American Institute Of Architects Architectural Graphics Standards* (7th ed.). New York: John Wiley & Sons, Inc., 1981

Reznikoff, S.C. *Interior Graphic and Design Standards.* New York: Whitney Library of Design, 1986.

Uniform Federal Accessibility Standards (Federal Standard 795). General Services Administration, Department of Defense, Department of Housing & Urban Development, and U.S. Postal Service, Washington D.C.: U.S. Govt. Printing Office, April 1, 1988. (1990 - 704-034/30206).

11. Regulatory and Code Compliance Agencies

American National Standards Institute, Inc. (ANSI)
1437 Broadway
New York, NY 10018
(212) 354-3300

American Society of Heating, Refrigerating, and Air Conditioning Engineers
1791 Tullie Circle, N.E.
Atlanta, GA 30329
(404) 636-8400

Building Officials and Code Administrators International
4051 West Flossmoor Road
Country Club Hills, IL 60477-5795
(312) 799-2300

Illuminating Engineering Society of North America
345 E. 47th Street
New York, NY 10017
(212) 705-7000

National Fire Protection Association
P.O. Box 1901, 1 Batterymarch Park
Quincy, MA 02269
(617) 770-3000

United States Architectural and Transportation Barriers Compliance Board
1111 18th St. N.W., Suite 501
Washington, D.C. 20036-3894
(800)USA-ABLE

United States Department of Justice
Civil Rights Division
Coordination and Review Section
P.O. Box 66118
Washington, D.C. 20035-6118
(202) 514-0301 (ADA Information Hotline)

APPENDIX C
BOOKS AND ARTICLES

Allen, Laurie. *A School Handbook on Classroom Amplification Equipment*, Keystone Area Education Agency 1, American Speech-Language-Hearing Association Convention, Seattle, 1990.

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APPENDIX D
PROFESSIONAL ORGANIZATIONS

I. Facility Design and Construction Related Associations

American Institute of Architects (AIA)
1735 New York Ave., N.W.
Washington, D.C. 20006
http://www.aia.org/

Business & Institutional Furniture Manufacturers Association (BIFMA)
2335 Burton, S.E.
Grand Rapids, MI 49506
(616) 243-1681

Environmental Design Research Association, Inc.
P.O. Box 24083
Oklahoma City, OK 73124
(405)232-2655

II. Facility Design and Management Organizations

Council of Educational Facility Planners, International (CEFPI)
941 Chatham Lane, Suite 217
Columbus, OH 43221
(614) 442-1811

Higher Education Facilities Management Association, also known as
Association of Physical Plant Administrators (APPA)
1446 Duke Street
Alexandria, VA 22314-3492
(703) 684-1446
http://www.appa.org/

International Facility Management Association (IFMA)
1 Greenway Plaza, 11th Floor
Houston, TX 77046
(713) 623-4362

National Association of College and University Business Officers (NACUBO)
1 Dupont Circle, Suite 500
Washington, D.C. 20036
(202) 861-2500
http://www.nacubo.org

Society for College and University Planning
4251 Plymouth Road, Suite D
Ann Arbor, MI 48105-2785
(313)998-7832
Internet: SCUP@UMICH.EDU
http://www.umich.edu/~scup/

III. Library, Media, and Technology Organizations

American Association of School Librarians (AASL)
50 E. Huron St.
Chicago, IL 60611
(312) 280-4386; (800) 545-2433

American Library Association (ALA)
50 E. Huron St.
Chicago IL 60611
(312) 944-6780; (800) 545-2433
http://www.ala.org/

Association of Audio-Visual Technicians
P.O. Box 101264
Denver, CO 80250
(303) 6948-1820

Association of College and University Telecommunications Administrators (ACUTA)
152 Zandale Dr., Suite 200
Lexington, KY 40503
(606) 278-3338
http://www.acuta.org

Association for Educational Communications and Technology (AECT)
1025 Vermont Avenue, NW, Suite 820
Washington, D.C. 20005
(202) 347-7834
http://www.aect.org/

Association for Information Media and Equipment Management (AIME)
P.O. Box 1173
Clarkesdale, MS 38614
(601) 624-9355

Communications Media Management Association
607 Arbor Avenue
Box 227
Wheaton, IL 60189
(708) 653-9355

Consortium of College and University Media Centers (CCUMC)
c/o Media Resources Center
121 Pearson Hall
Iowa State University
Ames, IA 50011-2203
(515) 294-1811

Educational Products Information Exchange (EPIE) Institute
103 W. Montauk Highway, Suite 5
Hampton Bays, NY 11946
(516) 728-9100

International Communications Industries Association (ICIA)
3150 Spring St.
Fairfax, VA 22031-2399
(703) 273-7200

International Television Association (ITVA)
6311 N. O'Conner Road, Suite 230
Irving, TX 75039
(214) 869-1112
http://www.itva.org/

National Association of Regional Media Centers Association (NARMC)
P.O. Box 1109
Council Bluffs, IA 33950
(712) 366-0503, ext. 237

National Multimedia Association of America
4920 Niagara Road, 3rd Floor
College Park, MD 20740
(301) 474-4107; (800) 214-9531
http://www.nmaa.org/

University Film and Video Association (UFVA)
Memphis State University
Memphis, TN 38152
(901) 678-2565

IV. Adaptive Facility Design and Equipment Organizations

AbleData
Newington Children's Hospital
181 East Cedar St.
Newington, CT 06111
(800) 344-5405
Maintains database with more than 15,000 listings of adaptive devices for all types of disabilities.

National Support Center for Persons with Disabilities
P.O. Box 2150
Atlanta, GA 30055
(800) 426-2133
Provides information on computer accommodation technology.

National Center for Access Unlimited
15522 K St. N.W., Suite 112
Washington, D.C. 20005
(202) 842-1266
A joint venture of United Cerebral Palsy Associations of Washington, D.C. and the Adaptive Environments Center of Boston. Consults with businesses to remove architectural, communication, and program barriers to persons with disabilitis. Provides information, consultation, training, and technical assistance on the Americans with Disabilities Act.

National Organization on Disability
910 Sixteenth Street, NW
Washington, D.C. 20006
(202) 293-5960
http://www.nod.org/
Nonprofit organization serving as an information clearinghouse for the disabled.

National Rehabilitation Information Center
8455 Colesville Rd., Suite 935
Silver Spring, MD 20910
(800) 588-9284
Maintains a research database of information on disability and rehabilitation.

Project EASI - Equal Access to Software and Information
associated with Educom and Association for Higher Education
http://www.rit.edu:80/~easi/
Website dedicated to collecting and disseminating up-to-date information about how to provide access for persons with disabilities to computing and information resources.

V. Websites

The following websites contain information on classrooms, especially those with technology.

Institute for Academic Technology
http://www.iat.unc.edu/

Smarter College Classrooms Page
http://classrooms.com

APPENDIX E
AUTHOR'S BIOGRAPHIES

Robert L. Allen was Director of Audio Visual Services and Chair of the University-wide Classroom Improvement Committee at Penn State University prior to his retirement in 1994. He has been a frequent speaker at national educational meetings on the need for the improvement of teaching facilities. He also has served as a consultant to both public schools and institutions of higher education regarding the design of new and renovated classrooms.

J. Thomas Bowen, Assistant to the Vice President for Academic Affairs at The University of Georgia, has worked in various roles of higher education administration for 26 years. He has a doctorate in higher education and during the last six years has taught an undergraduate course titled "Organizational Communication." He has served for the last five years as Chairman of the Professional Development Committee for the Society for College and University Planning (SCUP). In addition, he is a partner in the higher education consulting firm, Comprehensive Facilities Planning, Inc.

Sue Clabaugh was Director of the Educational Technology Center at the University of Maryland at College Park for 17 years. She recently served as Director of Distance Learning before joining the Teaching Technologies Group of UMCP's Academic Information Technology Services. In addition, she teaches for UMCP's College of Library and Information Services. She has a master's degree in educational media and a doctorate in Curriculum and Instruction with an emphasis in Educational Communications and Technology. She has worked on numerous classroom design and renovation projects, has served on many university-wide and state-wide technology committees, and has presented at national meetings. Her areas of expertise include instructional facilities design, media production and utilization, distance learning, and instructional development.

Beth DeWitt is currently Acting Assistant Controller at the Ohio State University. In her previous position, as a Facilities Planner in the Office of Campus Planning at OSU, she coordinated classroom design standards, programmed renovation and new construction projects, and served on the Classroom Readiness Sub-Committee, an interdepartmental team of professionals working toward improving the teaching and learning environment. Her involvement with classrooms began when she worked as Assistant Registrar for Scheduling where she was responsible for producing the master schedule of classes, documenting instructional requirements, and identifying classrooms needing replacement or renovation.

JoEllen Francis is an Assistant Director of Facility Planning and Management at the University of Illinois, Urbana-Champaign. She has a combined Master's in Design/Environmental Analysis and Urban Planning from Cornell University. Her areas of specialty include facility planning, classroom planning and remodeling, eliciting and analyzing user requirements, program statements and barrier removal for ADA compliance.

John Kerstetter, Director of Audio Visual Services at Kent State University, has nearly 30 years experience in the field of instructional technology in higher education. He has been active in Ohio's state media associations and the Consortium of College and University Media Centers, serving on numerous committees and holding a variety of leadership positions.

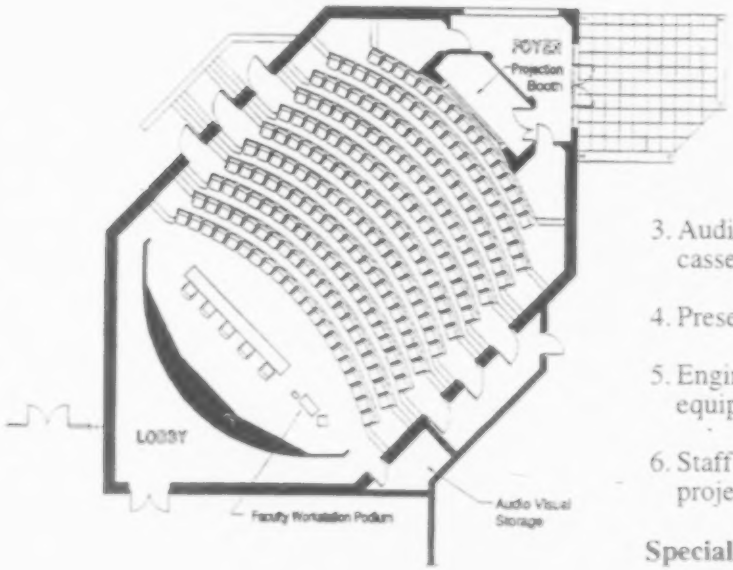
Donald Rieck is Director of the Media Resources Center at Iowa State University. He has over 25 years of experience in media instruction and administration. He has held numerous leadership positions in professional associations and is currently the Executive Director for the Consortium of College and University Media Centers, a national media organization. He holds a master's degree in Audiovisual Communications and a Ph.D. in Higher Education Administration. His academic

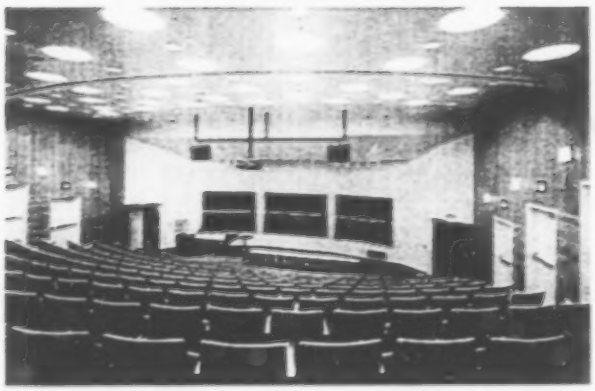
specialties include facility design incorporating electronic technology, the utilization/selection of media for the instructional process, and educational technology forecasting (delphi research techniques). He currently serves as an adjunct assistant professor in the Curriculum and Instruction Department of the College of Education, chairs the university-wide Instructional Resources Committee, and coordinates media facility planning support provided to the University Facilities Planning and Management divisions by the MRC. He also is working on several consulting projects with off-campus agencies.

APPENDIX F
FACILITY PROFILES

Sometimes words don't adequately convey the concepts related to good classroom design. For this reason, several profiles are included here which contain layouts, pictures, and brief descriptions of various types of instructional facilities. These are intended to be examples of various types of learning environments that might be useful to facility planners.

Institution: University of California, Santa Cruz
Classroom Type: Lecture Hall





Photos © Timothy Hursley

Functions:

1. Faculty workstation podium integrates technologies
2. Image display: computer/data display, video, cable tv, slides, 16mm film, laser-disc, CD-ROM, World Wide Web, etc.
3. Audio: accompanying images, CD, audio cassette, etc.
4. Presentation: lighting, microphones, acoustics
5. Engineering support: ease of trade-out of equipment, maintenance, repair
6. Staff support: compatible capabilities from projection booth

Special Features:

1. A 275 seat lecture hall designed to accommodate a wide range of instructional activity and methodology
2. Designed for flexible, easy-to-use integration of multimedia technology
3. Capability to meet instructor demands
4. High percentage of "up" time

Architects:
McLellan & Copenhagen
10051 Pasadena Avenue
Cupertino, CA 95014-5916

Zimmer Gunsul Frasca Partnership
320 S. W. Oak Street, Suite 500
Portland, OR 97204

For Additional Information, Contact:
Janis L. Dickens, Director
Media Services
McHenry Library
University of California, Santa Cruz
Santa Cruz, CA 95064
(408) 459-3429 phone
(408) 459-8206 fax
jdickens@cats.ucsc.edu
http://www.media services.uscs.edu

Institution: University of Oklahoma
Classroom Type: Lecture Hall

Special Features:

1. AMX computer-based remote control system facilitates smooth presentations by maintaining a communications link among the video/data projector, videotape player, laserdisc player, slide projectors, screen, sound system, and all the lighting to allow seamless integration of all controls for the operator.

2. All the instructional equipment is secured either in the projection booth or a locking cabinet.

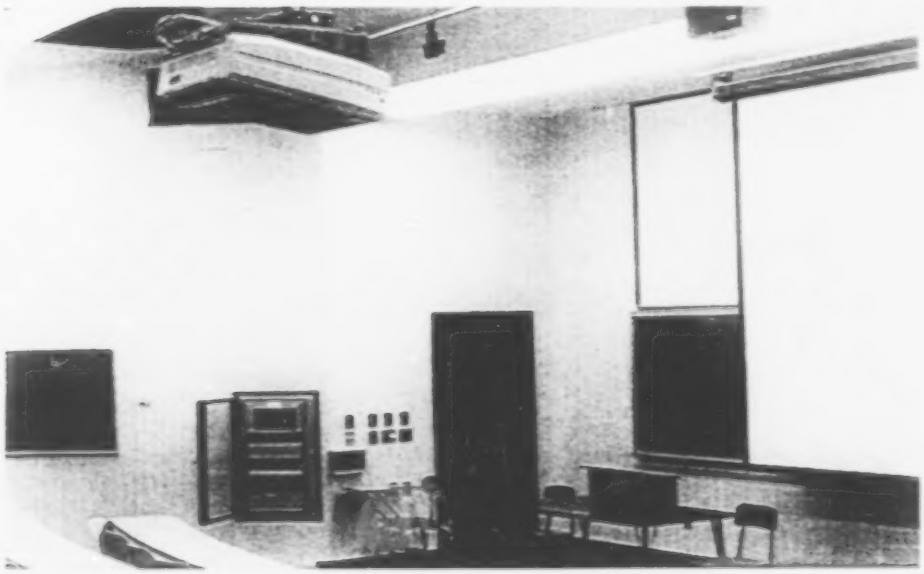
Functions:

1. Multi-purpose auditorium classroom for classes of 400 or more enrollment

2. multi-media presentation capability:
   three gun video/data projector
   computer interface capability
   connection to Univ. computer network
   S-VHS videotape player
   laserdisc player
   dual slide projectors

3. 16mm film projector used by student and departmental film groups

4. sound system with wireless mic



Planner:

Ben Kinder, Director
Physical Plant
University of Oklahoma
Norman, OK 73019

AMX System Design:

Osco, Inc.
Oscar Selling
P.O. Box 13557
Oklahoma City, OK 73113
(405) 749-8686

For Additional Information, Contact:

Lisa Portwood, Director
Instructional Services Center
231 Collings Hall
University of Oklahoma
Norman, OK 73019
(405) 325-4205

Institution: University of Oklahoma
Classroom Type: Seminar Room/Small Classroom

Functions:

1. Classrooms used by small classes (25-50 students) have tablet arm chairs.
2. Seminar rooms have tables and chairs.

Special Features:

1. Cabinets are used as pedestals for 27" televisions and S-VHS videotape players.
2. Overhead projectors are stored within the cabinets on carts.
3. Seminar rooms have dedicated teleconference equipment locked in cabinets.

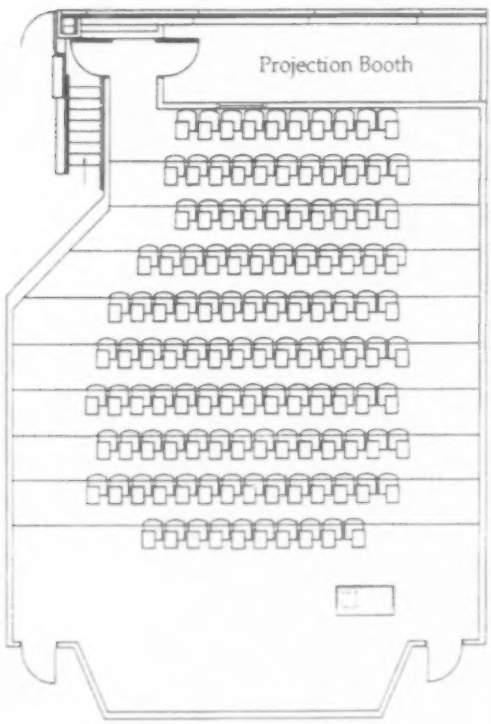
Planner:

Ben Kinder, Director
Physical Plant
University of Oklahoma
Norman, OK 73019

For Additional Information, Contact:

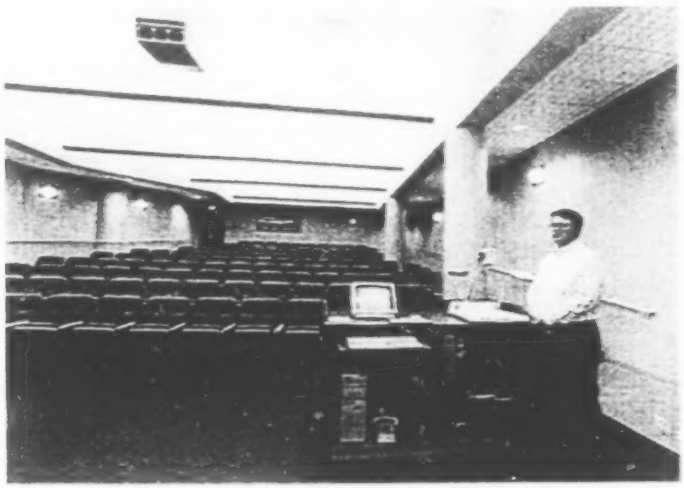
Lisa Portwood, Director
Instructional Services Center
231 Collings Hall
University of Oklahoma
Norman, OK 73019
(405) 325-4205

Institution: Wichita State University
Classroom Type: Mediated Classroom



Functions:

1. Allows for both PC and Macintosh computer applications with CD-ROM
2. Ethernet connection for Internet and WSU network mainframe access
3. Podium arrangement equipped with VHS, videodisc, "Elmo" overhead visual camera, cable TV, closed-circuit TV, and satellite downlink
4. RGB sync and audio/video input capabilities for external computer and audio/video source integration
5. Projection booth at back of room for 16mm film and slide projection
6. Video/data sources displayed from a ceiling mounted CRT projector onto a 14 ft. screen
7. Motorized tilt on projection screen for keystone reduction



Special Features:

1. Scan doubler for better display resolution
2. Wireless Audiolink sound reinforcement for the hearing impaired
3. Push button access panel for all video/data sources
4. 12 speaker house audio system
5. Telephone to call for emergency help

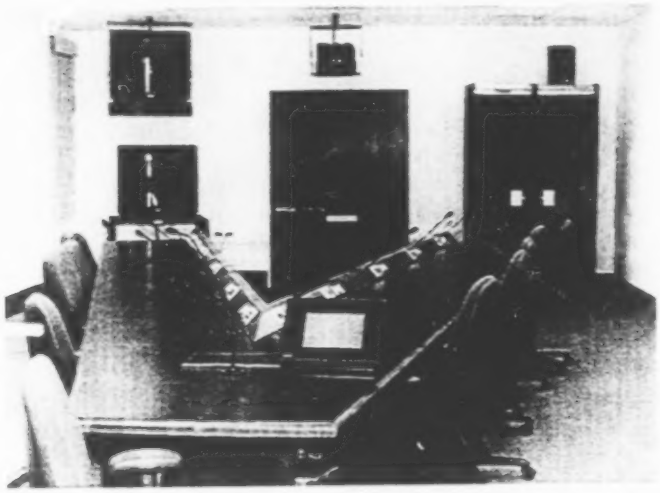
Planner:

John Gist
Wichita State University
Facilities Planning
1845 Fairmont
Wichita, KS 67260-0047

For Additional Information, Contact:

Duane Meis
Wichita State University
Media Resources Center
1845 Fairmont
Wichita, KS 67260-0057
(316) 689-3575 Phone
(316) 689-3560 Fax
meis@twsuvm.uc.twsu.edu

Institution: University of Illinois
Classroom Type: Distance Learning/Multimedia Classroom

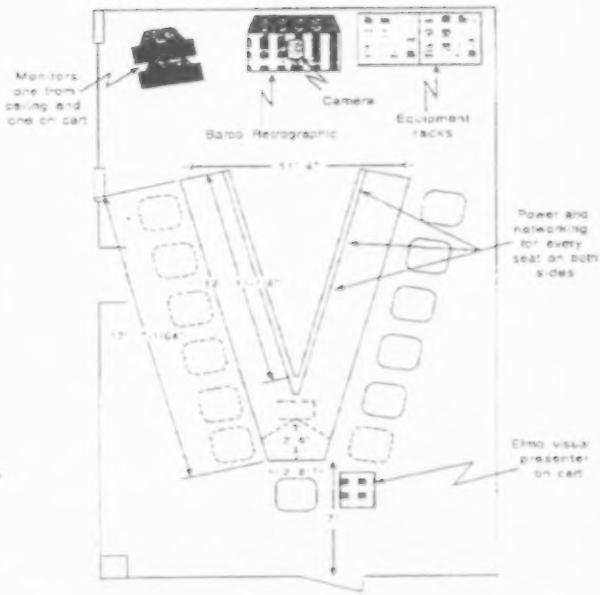


Functions:

1. Primary purpose is to support distance learning through videoconferencing.
2. Local classroom instruction involving multimedia presentations, with an emphasis on high resolution computer presentations.
3. Presentation room for committee meetings requiring multimedia capabilities, with an emphasis on high resolution computer graphic presentations.

Special Features:

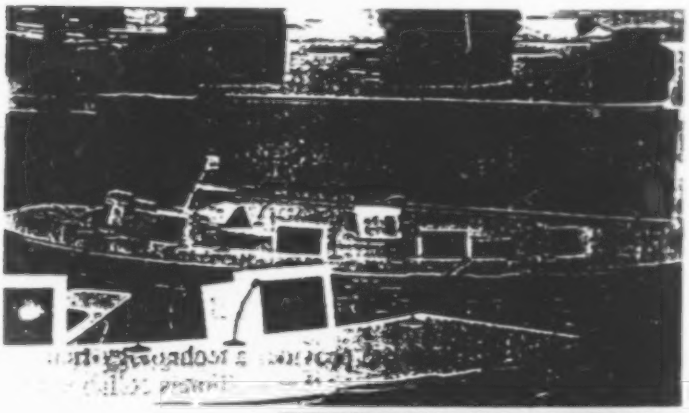
1. Automatic camera operation, allowing a "hands off" type of operation. Camera presets are controlled by the activation of the different microphones. This is accomplished through the use of camera presets, automatic mic mixer logic, and special programming in the control system.
2. Connection to the campus fiber optic video network for distribution on campus and access to the campus CODEC's.
3. Each work area has its own power and network connection.
4. The room can do videoconferences and audioconferences simultaneously which lets guest speakers into an already active videoconference or allows sites with no videoconferencing capability to participate.
5. The room has color-balanced fluorescent lighting and dimmable incandescent lighting that provide levels and zones to match different types of media presentations.
6. Visual display capability includes computer display, visual presenter, RS-232 controlled VCR, one camera, and fiber optic video.

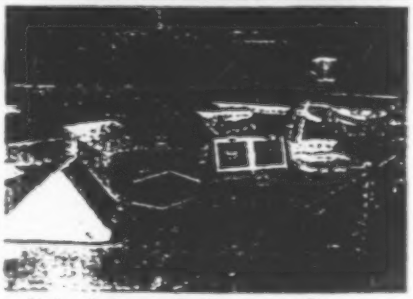


For Additional Information, Contact:

Dan Doolin
Office of Instructional Resources
156C Armory Building
University of Illinois
Champaign, IL 61820
(217) 333-4114

Institution: University of Illinois
Classroom Type: Distance Learning/Multimedia Classroom



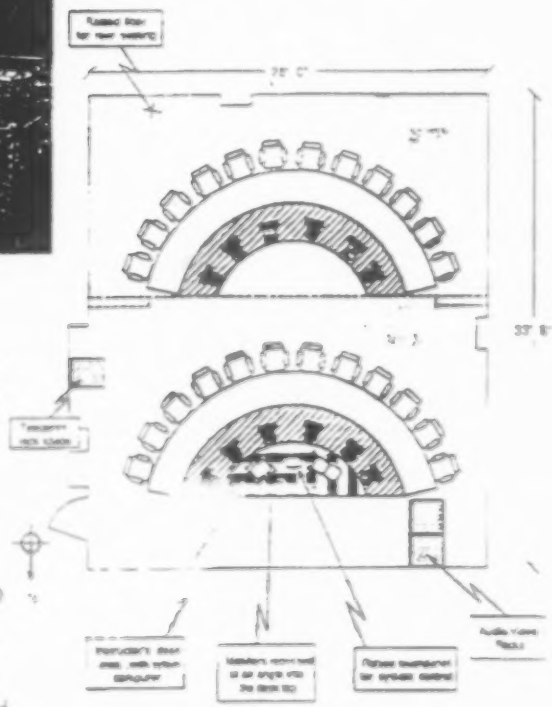


Special Features:

1. Automatic camera operation, allowing "hands off" type of operation. Camera presets are controlled by the activation of the different microphones. This is accomplished through the use of camera presets, automatic mic mixer logic, and special programming in the control system.
2. Connection to the campus fiber optic video network for distribution on campus and access to the campus CODEC's.
3. The room can do videoconferences and audioconferences simultaneously which lets guest speakers into an already active videoconference or allows sites with no videoconferencing capability to participate.
4. One 17" multisync monitor for every two students to accommodate high resolution computer graphics display and two 27" video monitors for each row of students.
5. The room has color balanced fluorescent lighting and dimmable incandescent lighting that provide levels and zones to match different types of media presentations.
6. Visual display capability includes computer display, visual presenter, RS-232 controlled VCR, one camera, and fiber optic video.

Functions:

1. Primary purpose is to support distance learning through videoconferencing and audioconferencing.
2. Local classroom instruction involving multimedia presentations, with an emphasis on high resolution computer presentations.
3. Presentation room for committee meetings requiring multimedia capabilities, with an emphasis on high resolution computer graphic presentations.



For Additional Information, Contact:

Dan Doolin
Office of Instructional Resources
156C Armory Building
University of Illinois
Champaign, IL 61820
217/333-4114

BEST COPY AVAILABLE

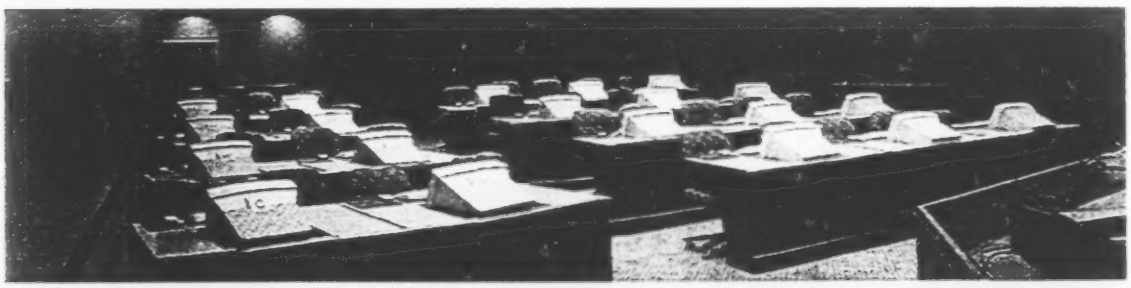
Institution: University of Maryland, College Park
Classroom Type: Technology Classroom

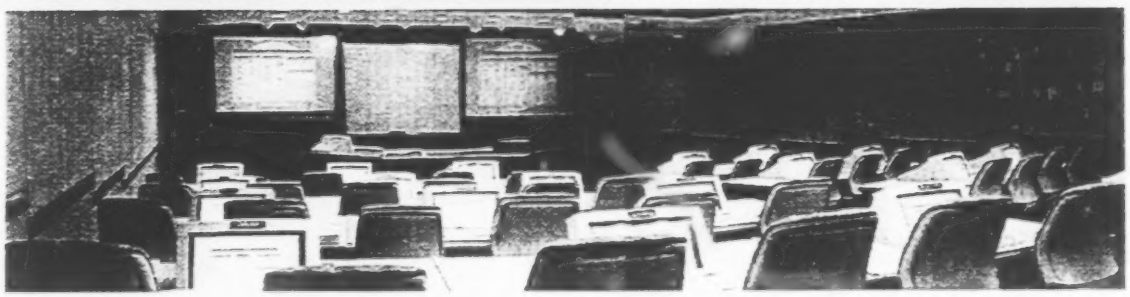
Special Features:

1. The room has 20 computers which can comfortably accommodate 2 users each.
2. The instructor has 2 computers and can control student screens and keyboards from the instructor console as well as show any student screen on either of the two projection screens at the front of the room.
3. Group collaboration software allows anonymous or identified responses and supports brainstorming, voting, and sharing.
4. The nstructor has access to a full range of multimedia and demonstration tools through a Crestron remote control system (2 projection screens, document camera, VCR's, campus cable tv, laser disc, CD-ROM, cassette decks, videoconferencing equipment, and 3 camera video recording system).
5. CPU's are housed in an adjacent room.
6. Whenever the room is used, a student technician is always on duty in the adjacent equipment room to provide technical support.

Functions:

1. The room provides a technology-rich environment that facilitates collaborative interaction.
2. The room is used primarily for classes but also serves as a facility for faculty training and meetings.





Planner:

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Teaching Technologies
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wg1@umail.umd.edu

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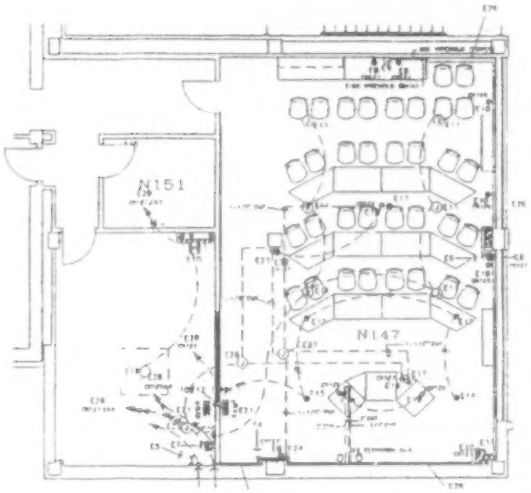
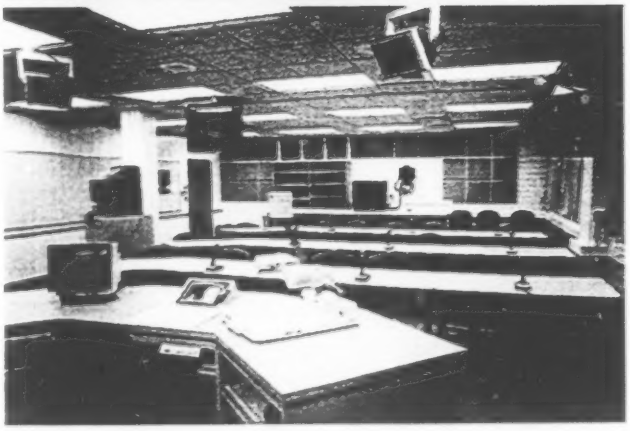
ey9@umail.umd.edu

Institution: Iowa State University
Classroom Type: Distance Education Classroom



Special Features:

1. Allows for the use of a variety of distance delivery technologies.
2. Operates as either an instructor-controlled or technician-controlled facility.
3. Provides flexible presentation approaches.
4. Created (remodeled) from an existing general classroom.
5. Includes an adjacent "control" area and additional observation seating.
6. Can function as a "production environment" for video recording.



Functions:

1. Was the initial university-wide two-way interactive video origination and reception site to the Iowa Communications Network.
2. Functions as the on-campus origination point for various electronic delivery "highways"--compressed, satellite and cable technologies.
3. Provides a video recording classroom for producing instructional material.
4. Allows continued research in distance education delivery and related activities.
5. Provides a centralized facility for distance education demonstrations and training activities for faculty and staff.
6. Functions as a student receive site for programming and activities from other providers of distance education.

Planner:

Scott Sankey
Facilities Planning/Management
General Services Building
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Matt Darbyshire
Media Resources Center
121 Pearson Hall
Iowa State University
Ames, IA 50011-2203
(515) 294-8022 phone

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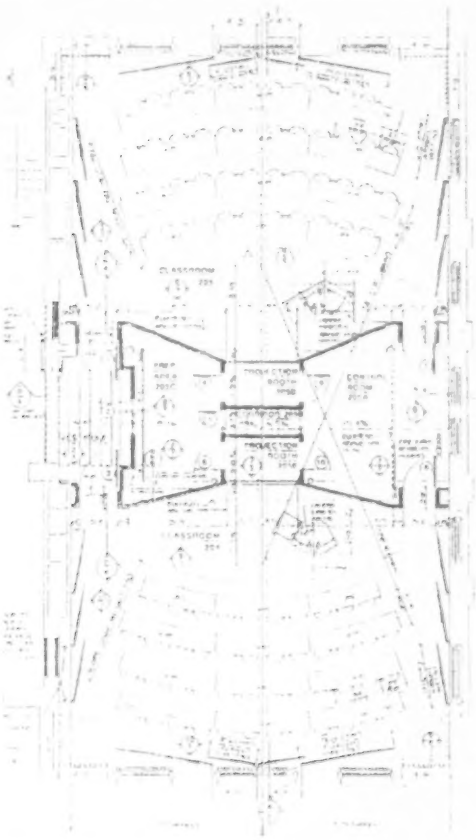
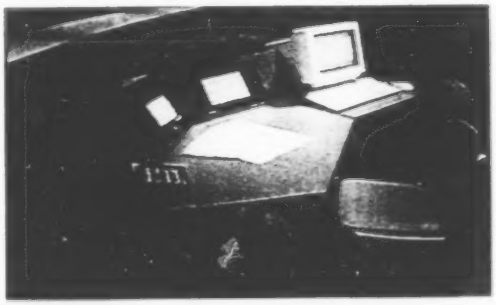
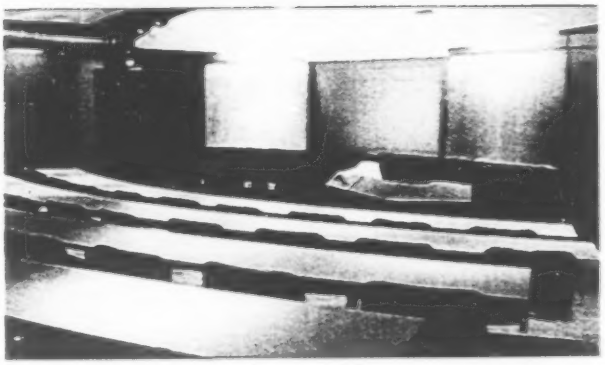
Institution: Iowa State University
Classroom Type: Presentation Rooms - Rear Screen



Functions:

1. Designed to provide two identical presentation spaces for innovative, technology-based engineering instruction.
2. Provided with the interconnectivity to allow the two rooms to function as one facility.
3. Allows for the display of high quality computer, web, and other digital images.
4. Constructed within an existing obsolete space requiring major physical and environmental changes.
5. Planned and financed through major corporate sponsorships and gifts.
6. Designed to provide for continuous upgrading of the technologies and functions of the rooms.





Special Features:

1. High technology, corporate image and financed facility.
2. Rear screen high quality computer display.
3. Modular instructor stations.
4. Faculty preparation area.
5. Wireless instructor control systems.
6. Variety of lighting and sound pre-set scenes.

Planner:

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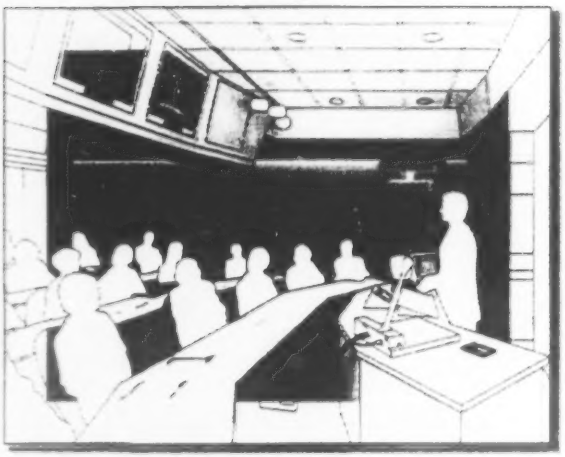

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